



Digital dividend: 600 MHz band  
and geographic interleaved  
spectrum  
Consultation on potential uses

Consultation

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## Section 1

# Executive summary

- 1.1 The 600 MHz band and geographic interleaved spectrum are part of the UK's digital dividend that will be freed up for new uses with the switchover from analogue to digital terrestrial television (DTT) that is due to be completed in 2012. We are considering how to make the spectrum available in ways that best suit the needs of potential users, in order to maximise the total value to society they generate over time. We intend to publish proposals on this later in 2010.
- 1.2 This consultation aims to:
  - update stakeholders on spectrum availability, how developments have changed this and how technical considerations may affect spectrum use; and
  - seek stakeholders' input on potential uses of the spectrum and on their level of interest in acquiring it. This information will help us develop proposals on how best to make the spectrum available.
- 1.3 In summer 2008, we consulted on the detailed design of the digital-dividend awards. At that time, we proposed to award the upper and lower bands of cleared spectrum together and to hold a series of awards of geographic lots of interleaved spectrum.
- 1.4 Several important developments have since caused us to reconsider our summer 2008 proposals. The main one is our decision to align our upper cleared band with the 800 MHz band identified for release by an increasing number of other European countries. This means clearing some existing and planned authorised uses from the 800 MHz band and negotiating new DTT allocations with neighbouring countries. There will be knock-on effects for the lower cleared (600 MHz) band and geographic interleaved spectrum in terms of both what we can award and when we can award it. We will not know precisely what they are until those negotiations are completed, probably later in 2010.
- 1.5 In reconsidering the award of this spectrum, we want to take into account how demand for it might have changed since summer 2008. This may be particularly relevant to the 600 MHz band now that the 800 MHz band is much more likely to be used for new mobile-broadband applications. But there may also be other potential uses and users for the geographic interleaved spectrum that could affect how we design its award. We will look in particular at the benefits that could arise from combining some geographic interleaved lots with the 600 MHz band.
- 1.6 There is a wide range of potential uses of this spectrum, the most likely of which appear to be DTT and mobile broadband alongside others including mobile multimedia services (MMS – e.g. mobile television), programme making and special events (PMSE), broadband wireless access (BWA) and communications for the emergency services. We consider each in turn and ask for stakeholders' views on these and any other potential uses. Our assessment takes into account the spectrum likely to be available and the likely technical constraints on its use. We also look at whether there may be distinctive considerations and uses in the nations and regions of the UK.
- 1.7 We expect to publish proposals for consultation on packaging and award design when there is greater certainty over what spectrum will be available for award. This is

likely to happen when international negotiations are further advanced later in 2010. In order to be in a position to publish our proposals as soon as possible, we will start to develop them before completion of these negotiations. The information we receive in response to this consultation will help us in this work.

- 1.8 Our aim is to be in a position to award the spectrum so that new use can be made of it from the end of digital switchover (DSO) in late 2012.

## Section 2

# Introduction

2.1 In this section, we explain the main decisions from our Digital Dividend Review (DDR) and the proposals we made in summer 2008 on the awards of the digital dividend.

## The DDR

2.2 The digital dividend is the spectrum that is freed up for new uses by DSO. We launched the DDR in 2005 with the objective of maximising the total value to society generated by the use of this spectrum over time. More information about the DDR, along with previous DDR publications, is available on our website at [www.ofcom.org.uk/radiocomms/ddr/](http://www.ofcom.org.uk/radiocomms/ddr/).

2.3 There are two distinct categories of spectrum in the digital dividend:

- cleared spectrum – the spectrum that by the end of 2012 will be fully cleared of existing uses, primarily analogue terrestrial television; and
- interleaved spectrum – capacity available within the spectrum that will be used after DSO to carry the six existing DTT multiplexes.<sup>1</sup> The interleaved spectrum is so called because it can be used at a local level on a shared – or interleaved – basis with terrestrial television.

2.4 This consultation concerns both that part of the cleared spectrum known as the 600 MHz band and geographic lots of interleaved spectrum.

2.5 The DDR concluded with the publication of our 13 December 2007 statement on our approach to awarding the digital dividend.<sup>2</sup> Some of the key decisions we took were:

- to confirm our proposal to take a market-led approach to awarding the digital dividend. In doing so, we decided to auction most of this spectrum and to give users flexibility to decide its optimum use. We believe auctions are the most open, transparent and non-discriminatory way of determining who should hold spectrum licences. A well designed auction process should have an efficient outcome (i.e. it should give the maximum flexibility for the market to determine the highest-value use of the spectrum and the identity of the users);
- not to intervene to reserve the spectrum for any particular use except for a single package of interleaved spectrum we would award via a beauty contest to a band manager with obligations toward PMSE users;

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<sup>1</sup> These multiplexes currently make up the UK's DTT platform, commonly referred to as Freeview. It comprises Multiplex 1 (operated by the BBC), Multiplex 2 (operated by Digital 3&4, jointly controlled by the Channel 3 licensees and Channel 4), Multiplex A (operated by SDN, controlled by ITV plc), Multiplex B (operated by BBC Free to View Ltd.) and Multiplexes C and D (operated by Arqiva). The three multiplexes operated by the BBC and Digital 3&4 are called public-service broadcasting (PSB) multiplexes, and the three remaining multiplexes are called commercial multiplexes. After DSO, at least 98.5% of UK households will be able to receive the three PSB multiplexes. The three commercial multiplexes are expected to reach around 90% of households.

<sup>2</sup> [www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf](http://www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf).

- to auction geographic lots of interleaved spectrum suitable but not reserved for local television;
- to include channel 36 – to be cleared of aeronautical radar – in the award of the cleared spectrum and to propose awarding the interleaved spectrum in channels 61 and 62 alongside this spectrum to maximise the potential benefits of harmonised spectrum use within Europe;
- to allow cognitive devices access to the interleaved spectrum on a licence-exempt basis as long as we were satisfied they would not cause harmful interference to licensed uses, including DTT and PMSE, but not to set aside any of the digital dividend exclusively for licence-exempt use or as an innovation reserve; and
- to proceed with awarding the digital dividend as soon as possible.







### Make-up of the digital dividend at December 2007

2.6 Figure 1 below shows the two different categories of spectrum in the digital dividend as of December 2007 in the context of the wider use of UHF Bands IV and V (470-862 MHz) that has been allocated in Europe, the Middle East and Africa for television broadcasting. There are different ways of referring to this spectrum. It is often referred to by channel number, each channel comprising 8 MHz of spectrum. It may also be referred to by frequency ranges (e.g. channel 21 occupies the frequency range 470-478 MHz).

Figure 1. The digital dividend at December 2007

Channel	21	22	23	24	25	26	27	28	29	30	31	32
Frequency (MHz)	470-478	478-486	486-494	494-502	502-510	510-518	518-526	526-534	534-542	542-550	550-558	558-566
	33	34	35	36	37	38	39	40	41	42	43	44
	566-574	574-582	582-590	590-598	598-606	606-614	614-622	622-630	630-638	638-646	646-654	654-662
	45	46	47	48	49	50	51	52	53	54	55	56
	662-670	670-678	678-686	686-694	694-702	702-710	710-718	718-726	726-734	734-742	742-750	750-758
	57	58	59	60	61	62	63	64	65	66	67	68
	758-766	766-774	774-782	782-790	790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854
	69											
	854-862											

 Interleaved spectrum	 Aeronautical radar - to be included in cleared award	 Interleaved spectrum - to be included in cleared award
 Cleared spectrum	 Radio astronomy	 PMSE

### Consultations on the digital-dividend awards

2.7 In summer 2008, we published three separate consultations on implementing the digital dividend awards:

- award of the cleared spectrum (6 June 2008);<sup>3</sup>
- geographic interleaved awards (12 June 2008);<sup>4</sup> and
- award of most of the interleaved spectrum and channel 69 via a beauty contest to a band manager with PMSE obligations (31 July 2008).<sup>5</sup>

### **Proposals set out in the June 2008 consultation on the award of the cleared spectrum**

- 2.8 In this consultation, we proposed an award of the contiguous cleared spectrum at 550-630 MHz and 806-854 MHz. This was the single largest group of bands considered in the DDR. It comprised 128 MHz of spectrum:
- 112 MHz of spectrum that would be released as a consequence of DSO;
  - 8 MHz that would be released by clearing aeronautical radar from channel 36; and
  - an additional 8 MHz that would be cleared as a result of the decision by the UK authorities responsible for radio astronomy to place channel 38 in the cleared award.
- 2.9 Our research showed there were a wide variety of potential uses of this spectrum. The most likely included mobile television, mobile broadband (including two-way mobile services) and DTT (in both standard definition – SD – and high definition – HD).
- 2.10 Consistent with our wider strategy, we planned to release the cleared spectrum in a way that would allow the widest possible range of potential users, in terms of services and technologies, to take part in the award. We proposed to award the spectrum as soon as possible and considered the auction could begin in summer 2009.

### **Proposals set out in the June 2008 consultation on the award of geographic interleaved spectrum**

- 2.11 In this consultation, we proposed a phased approach to the geographic interleaved awards.
- In the first phase, we would award lots for areas where DSO would take place before spring 2010 and there were existing local television stations operating under restricted television service licences (RTSLs – i.e. Cardiff, Carlisle and Manchester). These awards would take place in late 2008 or early 2009.
  - They would be followed by a combined award of lots for about 25 areas whose population was possibly large enough to support a local television station, or where there were existing RTSLs, and that might be suitable for aggregation to permit coverage of more than one area. This would take place in 2009, soon after the cleared award.

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<sup>3</sup> [www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf](http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf).

<sup>4</sup> [www.ofcom.org.uk/consult/condocs/ddrinterleaved/interleaved.pdf](http://www.ofcom.org.uk/consult/condocs/ddrinterleaved/interleaved.pdf).

<sup>5</sup> [www.ofcom.org.uk/consult/condocs/bandmgr/condoc.pdf](http://www.ofcom.org.uk/consult/condocs/bandmgr/condoc.pdf).



- The final phase would involve more individual awards of lots, like the first phase. We published a list of 81 candidate areas for these awards. We proposed to hold auctions only for those areas for which we received convincing expressions of interest or that were served by existing RTSLS. We proposed to hold awards in two stages: in early 2010 for areas facing DSO in 2011, and in early 2011 for areas facing DSO in 2012.

2.12 We identified additional DTT services – aimed at UK, national, regional or local markets – and PMSE as likely uses of the geographic interleaved spectrum. We thought those interested in providing mobile television would probably focus on the cleared spectrum. The feasibility of using interleaved spectrum for mobile broadband was still being investigated. Our most recent stakeholder research at that time supported our views.

### **Proposals set out in the July 2008 consultation on the award of spectrum to a band manager with PMSE obligations**

2.13 In this consultation, we set out detailed proposals for the award of spectrum, including interleaved spectrum, to a licensee that would act as band manager with an obligation to meet PMSE demand on fair, reasonable and non-discriminatory terms.

### **Structure of this document**

2.14 This document is structured as follows.

- Section 3 sets out developments since summer 2008 and the consequences for the 600 MHz band and geographic interleaved spectrum.
- Section 4 examines the availability and potential uses of this spectrum. It takes into account the spectrum that, in broad terms, might be available for award and the technical considerations that will affect how the spectrum may be used, in particular the need to protect adjacent services. It also considers whether there are particular issues for the nations and regions. Finally, it addresses our approach to awarding this spectrum in general and channel 36 within the 600 MHz band in particular.
- Section 5 sets out the next steps for the award of this spectrum.
- Annex 5 has information on DVB-T2 and frequency offsets.
- Annex 6 sets out our functions and duties as they relate to spectrum awards.

## Section 3

# Developments since summer 2008

- 3.1 This section describes the main developments since we consulted on the digital dividend awards in summer 2008 that have or may have a bearing on future use of the 600 MHz band and geographic interleaved spectrum. It covers:
- clearing the 800 MHz band;
  - the Digital Britain final report;
  - the independent spectrum broker's (ISB) final report and the Department for Business, Innovation and Skills' (BIS) consultation on a Government direction;
  - the European Commission Communication on the digital dividend;
  - clearing channel 36;
  - the awards of geographic interleaved spectrum for Manchester and Cardiff;
  - the Northern Ireland memorandum of understanding (MOU);
  - the award of spectrum to a band manager with PMSE obligations;
  - local and regional media publications, including our Local and Regional Media discussion document and the Department for Culture, Media and Sport's (DCMS) consultation on financing independently funded news consortia (IFNCs);
  - the final report of the Scottish Broadcasting Commission;
  - a Scottish Government document on opportunities for broadcasting;
  - the spectrum plan for the London 2012 Olympic Games and Paralympic Games;
  - cognitive devices; and
  - our consultation on spectrum information.

## Clearing the 800 MHz band

- 3.2 On 30 June 2009, we published a statement setting out our decision to align the upper band of cleared spectrum in the UK with the 800 MHz band being identified for release by an increasing number of other European countries.<sup>6</sup> This upper, 800 MHz band would then comprise 790-862 MHz (i.e. channels 61-69).
- 3.3 To do this, we decided to clear channels 61 and 62 of DTT and to use channels 39 and 40 instead so the total number of channels for DTT remained constant. We also proposed to clear PMSE from channel 69 and to make channel 38 available instead. Figure 2 below illustrates how the digital dividend will look after these changes, again in the context of the wider use of UHF Bands IV and V.

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<sup>6</sup> [www.ofcom.org.uk/consult/condocs/800mhz/statement/clearing.pdf](http://www.ofcom.org.uk/consult/condocs/800mhz/statement/clearing.pdf).

**Figure 2. The digital dividend after clearing the 800 MHz band**

Channel	21	22	23	24	25	26	27	28	29	30	31	32
Frequency (MHz)	470-478	478-486	486-494	494-502	502-510	510-518	518-526	526-534	534-542	542-550	550-558	558-566
	33	34	35	36	37	38	39	40	41	42	43	44
	566-574	574-582	582-590	590-598	598-606	606-614	614-622	622-630	630-638	638-646	646-654	654-662
	45	46	47	48	49	50	51	52	53	54	55	56
	662-670	670-678	678-686	686-694	694-702	702-710	710-718	718-726	726-734	734-742	742-750	750-758
	57	58	59	60	61	62	63	64	65	66	67	68
	758-766	766-774	774-782	782-790	790-798	798-806	806-814	814-822	822-830	830-838	838-846	846-854
	69											
	854-862											

<span style="display: inline-block; width: 20px; height: 10px; background-color: #f08080; border: 1px solid black;"></span> Interleaved spectrum	<span style="display: inline-block; width: 20px; height: 10px; background-color: #f0e6f0; border: 1px solid black;"></span> Cleared spectrum	<span style="display: inline-block; width: 20px; height: 10px; background-color: #e0f0ff; border: 1px solid black;"></span> PMSE
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- 3.4 These decisions have the effect of reducing the amount of spectrum available for new services in the lower, 600 MHz band of cleared spectrum. This band now comprises 56 MHz in total. It covers channels 31-37 (i.e. 550-606 MHz). Section 4 explores in more detail the spectrum in the 600 MHz band that may be available for award.
- 3.5 The amount of geographic interleaved spectrum will also be affected. As DTT moves below channel 61 in both the UK and neighbouring countries clearing their 800 MHz band, channels 21 to 60 will become more intensively used. This will reduce the availability of geographic interleaved spectrum for other services. The materiality of this impact will be highly dependent on the exact outcomes of international negotiations and the coordination and UK planning arrangements that flow from them. We continue to believe there is likely to be suitable geographic interleaved spectrum available that could be used for other services. We will not know the exact details of what will be available for award, and where, until after the completion of the negotiations.
- 3.6 The timescales for awarding the 600 and 800 MHz bands and geographic interleaved spectrum will all be affected by clearing the 800 MHz band. We need to agree revised transmission rights with our neighbours to enable us to effect the necessary changes to spectrum allocations. Of particular relevance to this consultation is our desire to secure appropriate rights to allow two DTT multiplexes to operate in the 600 MHz band, recognising the likelihood that the 800 MHz band will be used for other services.
- 3.7 We think it likely negotiations for the main high-power sites will last well into 2010 and may not be finalised until 2011. However, we believe it is credible agreements will be reached on a revised main-station frequency plan later in 2010, with a revised plan for relays following that.

## Digital Britain final report

- 3.8 On 16 June 2009, the Government published its Digital Britain final report.<sup>7</sup> The report provided actions and recommendations to promote and protect talent and

<sup>7</sup> [www.culture.gov.uk/images/publications/digitalbritain-finalreport-jun09.pdf](http://www.culture.gov.uk/images/publications/digitalbritain-finalreport-jun09.pdf).

innovation in the UK's creative industries, to modernise television and radio frameworks and to support local news and introduced policies to maximise the social and economic benefits from digital technologies.

3.9 The report was one of the central policy commitments in the Government's Building Britain's Future plan and draft legislative programme. Measures proposed in the report included:

- a three-year national plan to improve digital participation;
- universal access to today's level of broadband services by 2012;
- the creation of a next generation fund for investment in future broadband services;
- digital-radio upgrade by the end of 2015;
- mobile-spectrum liberalisation, enhancing 3G coverage and accelerating next-generation mobile services;
- a robust legal and regulatory framework to combat digital piracy;
- support for public-service content partnerships;
- a revised digital remit for Channel 4; and
- a consultation on funding options for national, regional and local news.

### **The ISB's final report and BIS's consultation on a Government direction**

3.10 In the Digital Britain final report, the Government set out its objectives for mobile broadband. An ISB was appointed and subsequently presented a set of proposals to enable the release of additional spectrum into the UK market. The Government has said it sees the ISB's proposals as a sound platform and intends to direct us to implement them. The Government has the power to direct us, subject to approval from Parliament, but is required by statute to consult on any direction. On 16 October 2009, BIS therefore published a consultation document.<sup>8</sup> The closing date for responses was 5 February 2010.

### **European Commission Communication on the digital dividend**

3.11 On 28 October 2009, the Commission published Communication COM(2009) 586/2 on transforming the digital dividend into social benefits and economic growth.<sup>9</sup> It outlined a set of proposals for a common approach to the digital dividend in Europe so immediate progress can be made on the urgent challenges while allowing for adequate preparation for the key strategic and longer-term issues that must be decided together. The Commission grouped these proposals under three headings:

- urgent action to unleash initial benefits –

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<sup>8</sup> [www.berr.gov.uk/files/file53061.pdf](http://www.berr.gov.uk/files/file53061.pdf).

<sup>9</sup>

[http://ec.europa.eu/information\\_society/policy/ecomms/radio\\_spectrum/document\\_storage/other\\_docs/en\\_com586\\_dd.pdf](http://ec.europa.eu/information_society/policy/ecomms/radio_spectrum/document_storage/other_docs/en_com586_dd.pdf).

- achieving complete switch-off of analogue television by 2012; and
- providing a template for coherent opening of the 800 MHz band for electronic communications services by adopting harmonised technical conditions of use;
- measures requiring a strategic direction –
  - adoption of a common European Union (EU) position with a view to more effective cross-border coordination with non-EU countries;
  - achieving the EU-wide opening of the 800 MHz band to electronic communications services; and
  - applying a minimum level of spectrum efficiency regarding future uses of the digital dividend; and
- looking forward to further improvements in the use of the digital dividend –
  - promoting collaboration between Member States to share future broadcasting network deployment plans (e.g. migration to MPEG-4 or DVB-T2);
  - requiring all DTT receivers sold in the EU after a certain date (to be defined) to be ready to operate with a digital transmission compression standard of the new generation such as the H264/MPEG-4 AVC standard;
  - setting a minimum standard for the ability of DTT receivers to resist harmful interference (immunity to interference);
  - considering wider deployment of single-frequency networks;
  - supporting research into frequency-agile mobile communications systems;
  - ensuring the continuity of wireless-microphone and similar applications by identifying future harmonised frequencies; and
  - adopting a common position on the potential use of the white spaces as a possible digital dividend.

3.12 The Commission intends to rely on the future radio-spectrum policy programme as the means to secure endorsement by the European Parliament and the Council of the main strategic elements in the future EU roadmap concerning the digital dividend. In the meantime, the Council adopted conclusions on the Commission's Communication on 17 December 2009.<sup>10</sup>

### Clearing channel 36

3.13 Channel 36 is an 8 MHz block of spectrum (590-598 MHz) within the 600 MHz band. Unlike the adjacent spectrum, it has not been used for analogue television broadcasting in the UK but rather aeronautical radar (with PMSE as a secondary use). In June 2009, we cleared channel 36 of this radar use. It may be of particular interest to stakeholders as it will be available across the UK before the rest of the 600 MHz band. Section 4 explores this point.

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<sup>10</sup> [www.consilium.europa.eu/uedocs/cms\\_Data/docs/pressdata/en/trans/112001.pdf](http://www.consilium.europa.eu/uedocs/cms_Data/docs/pressdata/en/trans/112001.pdf).

## **Awards of geographic interleaved spectrum for Manchester and Cardiff**

- 3.14 In February 2009, we held two auctions of geographic interleaved spectrum. Following the first auction, on 5 February we granted a wireless telegraphy licence covering the Manchester area to Channel M Television in respect of channel 57 (758-766 MHz). After a further auction, on 27 February we granted a wireless telegraphy licence covering the Cardiff area to Cube Interactive in respect of channel 30 (542-550 MHz).

## **Northern Ireland MOU**

- 3.15 There are two agreements in place between the governments of the UK and the Republic of Ireland concerning the relay of Irish television services in Northern Ireland. The first is the Belfast/Good Friday Agreement of 10 April 1998. This committed the UK Government to exploring urgently the scope for achieving more widespread availability of Irish language television service TG4, in Northern Ireland. The second is the MOU on the reciprocal relay of television services, signed on 1 February 2010.<sup>11</sup>
- 3.16 Both governments wrote to their respective spectrum regulators (us in the UK, the Commission for Communications Regulation in the Republic) in May 2009 asking that the spectrum negotiations between the two countries aim to identify suitable interleaved spectrum whose preferred use would be the relay of an additional low-capacity, low-power DTT multiplex in Northern Ireland capable of carrying the three services RTÉ One, RTÉ Two and TG4 on the three Northern Ireland main transmitters. The UK Government has indicated it is minded to direct us for this purpose. Suitable spectrum would need to be identified and awarded in line with any such direction.
- 3.17 There are some uncertainties in realising such a multiplex. The technical feasibility and the quality of available interleaved spectrum have both yet to be established. Because of these and other uncertainties, the option of carrying TG4 on the Digital 3&4 PSB multiplex in Northern Ireland after DSO in 2012 is being held open by DCMS. It is anticipated that RTÉ One, RTÉ Two and TG4 will, in any event, continue to be available in Northern Ireland after DSO by overspill from transmitters in the Republic. The extent of predicted coverage for this overspill has yet to be established.

## **Award of spectrum to a band manager with PMSE obligations**

- 3.18 We published a second consultation on the detailed design of the band-manager award on 22 June 2009.<sup>12</sup> This made further detailed proposals for how we expect the band manager to behave toward PMSE users and what this is likely to mean for them. The consultation closed on 7 September 2009. We will publish a statement on our decisions in due course.

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<sup>11</sup> [www.culture.gov.uk/images/publications/MoU-DCMS-DCENR.pdf](http://www.culture.gov.uk/images/publications/MoU-DCMS-DCENR.pdf).

<sup>12</sup> [www.ofcom.org.uk/consult/condocs/bandmanager09/bandmanager09.pdf](http://www.ofcom.org.uk/consult/condocs/bandmanager09/bandmanager09.pdf).

## Local and regional media publications

### Local and Regional Media discussion document

- 3.19 In our Second PSB Review, published on 21 January 2009,<sup>13</sup> we focused on the historic and continuing importance of television programming for the nations and regions. We recognised there were growing pressures on traditional models of delivering content to audiences across the different parts of the UK. We also highlighted the growing importance of content aimed at local audiences and the potential for new models of delivering such content.
- 3.20 We concluded we needed a more detailed analysis of the provision of public-service content at a local level and to consider the broader issues in the provision of local content across different media platforms. We therefore published a discussion document on 22 September 2009.<sup>14</sup>
- 3.21 In summary, this discussion document brought together our research and analysis relevant to our various duties in relation to the provision of local and regional content across the UK. It reviewed a range of opportunities and initiatives for sustaining a healthy and vibrant local-media sector in the future. It also provided an evidence base for our response to the DCMS consultation on funding for IFNCs (see below).
- 3.22 While consumer definitions of what is local are blurred, the discussion document primarily covered media on a regional (county or broader geographic area), local (town or local district) and ultra-local (immediate community or neighbourhood) basis. We also covered some of the broader media issues in the devolved nations of Northern Ireland, Scotland and Wales.
- 3.23 As regards local television, we noted it has the potential to deliver public purposes, whether through commercial or not-for-profit services. The success of community radio in particular shows voluntary and community-based local-television services may play an important role in the local-media sector in the future.
- 3.24 Although consumers see the value of local television, awareness of current services is low, and there are concerns about quality. On a commercial basis, the economics of running a local-television service are challenging. However, DSO could create new opportunities for delivering local-television services in the future.
- 3.25 We identified three different models for making local television available to UK viewers:
- a networked service. Taking this approach, viewers would receive a single, networked service, with content broadcast from a central location. This would be supplemented by local “opts” at certain times of day in areas where a local-television station was broadcasting. This is similar to the affiliate model of local-television in the United States;
  - a standalone local-television service. In this scenario, local-television stations would broadcast content specific to their own local area. Stations would be independent of each other, and viewers would only receive content where a local-television station was operating. This is similar to the Channel M service in Manchester; and

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<sup>13</sup> [www.ofcom.org.uk/consult/condocs/psb2\\_phase2/statement/psb2statement.pdf](http://www.ofcom.org.uk/consult/condocs/psb2_phase2/statement/psb2statement.pdf).

<sup>14</sup> [www.ofcom.org.uk/research/tv/reports/lrmuk/lrmuk.pdf](http://www.ofcom.org.uk/research/tv/reports/lrmuk/lrmuk.pdf).

- a hybrid service. Local-television stations would broadcast content specific to their local area, but at the same time they could join together to create syndicated content, available to viewers of all member stations. Syndicated content could be broadcast at specific times, or member stations could decide when to schedule it themselves.
- 3.26 Taking these three models, the discussion document identified a number of possible approaches to stimulating the development of local television in the UK.
- 3.27 One approach (also known as the Channel 6 proposal) could be for the Government to reserve capacity on an existing PSB multiplex from 2012. This could enable a UK-wide local-television network, accompanied by locally targeted output. Such a service could deliver significant reach and impact and deliver universal coverage across the UK. However, there would be a significant opportunity cost in using capacity in a PSB multiplex for this purpose.
- 3.28 Another approach would be to use geographic interleaved spectrum for local-television services.<sup>15</sup> Use of this spectrum could enable local television to be delivered in a large number of locations across the UK, but it would not deliver universal coverage. Operators might use the spectrum to create a network of local stations around a single sustaining feed of content. Alternatively, operators might bid for individual lots of interleaved spectrum to run local services independently of each other.
- 3.29 The Government's proposals for IFNCs could also create an important platform for the future development of local-television services by providing cost synergies that could make it more economically attractive to set up local-television services alongside regional news.

### **DCMS's consultation on financing IFNCs**

- 3.30 The Digital Britain final report made clear the Government's commitment to audiences having a choice of high-quality public-service content. The report made a particular case for intervention to prevent a decline in the provision of news in the nations, locally and in the regions. It set out proposals for introducing IFNCs that would provide news in the Channel 3 weekday schedule for the nations, locally and in the regions. The Government said it intended to trial this proposal first on a pilot basis in Scotland, Wales and one English region, with UK-wide rollout from 2013.
- 3.31 DCMS published a consultation document on 30 June 2009 to seek views on the proposal to provide top-up funding for IFNCs.<sup>16</sup> It proposed an element of the television licence fee to be set in 2013 might be a source of funding for which IFNCs would bid. It also sought views on alternative sources of funding. We responded to the consultation,<sup>17</sup> which closed on 22 September 2009.

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<sup>15</sup> The Conservative Party published a consultation on 15 July 2009 on creating viable local multimedia companies (LMCs) in the UK (see [news release](#)). It proposed LMCs would operate DTT services under local-television licences. The most effective way of allocating these new licences would be for us to award them as a single bundle, by auction, to a band manager responsible for assigning individual licences to LMCs. The licences would be based on the 81 localities we provisionally identified for the geographic interleaved awards in June 2008.

<sup>16</sup> [www.culture.gov.uk/images/consultations/cons\\_sustainableindependentnews.pdf](http://www.culture.gov.uk/images/consultations/cons_sustainableindependentnews.pdf).

<sup>17</sup> [www.ofcom.org.uk/consult/ofcomresponses/dcms.pdf](http://www.ofcom.org.uk/consult/ofcomresponses/dcms.pdf).



3.32 DCMS published the Government's response to the consultation on 16 November 2009.<sup>18</sup> On 26 November 2009, it announced the selection of Tyne Tees and Borders as a pilot region, in addition to Scotland and Wales, for trialling IFNCs.<sup>19</sup> On 13 January 2010, it announced the names of the eight consortia that had been successful in the first stage of the selection process.<sup>20</sup> Further information on the pilot tender process can be found on the DCMS website at [www.culture.gov.uk/what\\_we\\_do/broadcasting/5942.aspx](http://www.culture.gov.uk/what_we_do/broadcasting/5942.aspx).

### **Report to the Secretary of State for Culture, Media and Sport on the media-ownership rules**

3.33 Parliament has put in place media-ownership rules for television, radio and newspapers. In the interests of democracy, the rules aim to help protect plurality of viewpoints and give citizens access to a variety of sources of news, information and opinion. We have a statutory duty to review the operation of, and recommend any changes to, the media-ownership rules. We must report to the Secretary of State for Culture, Media and Sport at least every three years. In the Digital Britain final report, the Government asked us specifically to consider the impact of the current local-media ownership rules on the sustainability of local media. On 31 July 2009, we published a consultation that set out our proposed recommendations,<sup>21</sup> which stakeholders' responses generally supported.

3.34 On 17 November 2009, we published a report setting out our final recommendations to the Secretary of State, taking into account all consultation responses.<sup>22</sup> We found there was still strong reliance on television, newspapers and radio even though consumers are increasingly using the Internet as an alternative source of news. However, those industries were facing significant economic changes. These were most acute in local media. Some relaxation of the local ownership rules would benefit citizens and consumers by helping to ensure local content continued to be commercially provided. Therefore, we recommended:

- removing the local radio-service ownership rules and the local and national radio multiplex-ownership rules; and
- liberalising the local cross-media ownership rules so the only restriction is on owning all three of:
  - local newspapers (with 50% plus local market share);
  - a local radio station; and
  - a regional Channel 3 licence.

3.35 There was little current evidence of change since Parliament put in place media-ownership rules that affect the operation of the remaining rules. Therefore, we did not recommend changes to:

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<sup>18</sup> [www.culture.gov.uk/images/publications/Govtresponseto-consultation\\_on\\_sustainable\\_impartial\\_news\\_2009.pdf](http://www.culture.gov.uk/images/publications/Govtresponseto-consultation_on_sustainable_impartial_news_2009.pdf).

<sup>19</sup> [www.culture.gov.uk/reference\\_library/media\\_releases/6463.aspx](http://www.culture.gov.uk/reference_library/media_releases/6463.aspx).

<sup>20</sup> [www.culture.gov.uk/reference\\_library/media\\_releases/6569.aspx](http://www.culture.gov.uk/reference_library/media_releases/6569.aspx).

<sup>21</sup> [www.ofcom.org.uk/consult/condocs/morr/morrcondoc.pdf](http://www.ofcom.org.uk/consult/condocs/morr/morrcondoc.pdf).

<sup>22</sup> [www.ofcom.org.uk/consult/condocs/morr/statement/morrstatement.pdf](http://www.ofcom.org.uk/consult/condocs/morr/statement/morrstatement.pdf).

- the national cross-media ownership rules, which restrict cross-ownership of Channel 3 and national newspapers;
- ownership restrictions that apply to television and radio broadcasting licences to guard against undue influence by certain owners whose influence over content might cause concern;
- the appointed news provider rule, which helps ensure national and international news on Channel 3 is independent of the BBC and adequately funded; or
- the media public interest test, which continues to provide a backstop for the Government to intervene to prevent media mergers on public interest grounds, including for the protection of plurality.

3.36 It is for the Government to consider what action to take and ultimately for Parliament to make any changes through secondary legislation.

### **Final report of the Scottish Broadcasting Commission**

3.37 On 8 September 2008, the Scottish Government published the final report of the Scottish Broadcasting Commission.<sup>23</sup> The Commission made 22 recommendations for strengthening the broadcasting industry in Scotland.

3.38 Arguing Scotland needs a new framework for broadcasting to take it through the transition period of DSO, meet new challenges and grasp new opportunities, the Commission recommended:

- the creation of a new Scottish Network – a digital public-service television channel, with an extensive and innovative online platform, funded out of the new UK settlement for PSB plurality and licensed and given full regulatory support by us;
- the BBC Trust and Executive should –
  - fulfil the commitment to secure 8.6% of network-television production from Scotland (under our definition) by the end of 2012 and maintain that level, in line with population share, as a minimum thereafter; and
  - establish and maintain a substantial network-commissioning presence in Scotland and transfer the management of one of its four national television services to Scotland;
- Channel 4 should have a mandatory target for production from Scotland of 8.6%, in line with share of population, and base one of its commissioning departments in Scotland;
- all broadcasters in the UK should review the performance of their news services in reporting the four nations in a manner that is accurate and relevant for all;
- the Scottish Parliament should take an active role in considering the broadcasting industry and the services audiences in Scotland receive in order to provide a visible and public forum for debate, with Scottish Ministers having greater

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<sup>23</sup> [www.scottishbroadcastingcommission.gov.uk/Resource/Doc/4/0000481.pdf](http://www.scottishbroadcastingcommission.gov.uk/Resource/Doc/4/0000481.pdf).

responsibility, within the UK framework, for those operational functions directly affecting Scotland; and

- the influence and responsibilities of Ofcom Scotland should be strengthened, and there should be specific representation for Scotland on the Ofcom Board at UK level.

3.39 Responding to the Scottish Broadcasting Commission's final report, the Secretary of State for Scotland welcomed the underlying principle that Scottish broadcasting should remain an integral part of UK broadcasting

### **Scottish Government document on opportunities for broadcasting**

3.40 On 23 September 2009, the Scottish Government outlined possible future policy directions for indigenous Scottish broadcasting in the context of the Scottish Broadcasting Commission's final report.<sup>24</sup>

3.41 The paper suggested one consequence of key decisions being taken by the UK Government was Scottish broadcasting had been marginalised within the UK framework. A key challenge in establishing new operational arrangements for broadcasting in Scotland would be to retain the best elements of the existing UK broadcasting system while allowing for a greater level of programming that reflected Scottish life.

3.42 The final report of the Commission on Scottish Devolution had recommended in June 2009 that Scottish rather than UK Ministers should appoint the Scottish member of the BBC Trust.<sup>25</sup> This change could be implemented immediately. Scottish Ministers could also be given responsibility for approving the appointment of board members of MG Alba.

3.43 The Scottish Government's paper said there was scope to retain the major UK-wide broadcasting institutions while devolving greater powers to Scottish Ministers. Other countries in Europe (e.g. Germany and Spain) had devolved a greater level of responsibility for broadcasting than the UK Government. There were a number of measures that could be adopted to strengthen accountability for broadcasting in Scotland, in particular granting the Scottish Government the power to establish PSB bodies, such as a Scottish Digital Network.

3.44 Greater autonomy in broadcasting policy would give Scotland an opportunity to set priorities specifically attuned to the needs of viewers in Scotland. It was envisaged the existing assets and staff of BBC Scotland would form the basis of a Scottish national broadcaster. National events would be added that were prioritised and broadcast on free-to-air television. For example, Scotland's football qualifiers for the World Cup and European Championship were currently only available on satellite television, but a Government of an independent Scotland could make them available to all fans on terrestrial television.

### **Spectrum plan for the London 2012 Olympic Games and Paralympic Games**

3.45 We are responsible for organising a full spectrum plan for the London 2012 Olympic Games and Paralympic Games, for arranging all the licences in good time in support

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<sup>24</sup> [www.scotland.gov.uk/Resource/Doc/285350/0086693.pdf](http://www.scotland.gov.uk/Resource/Doc/285350/0086693.pdf).

<sup>25</sup> [www.commissiononscottishdevolution.org.uk/uploads/2009-06-12-csd-final-report-2009bookmarked.pdf](http://www.commissiononscottishdevolution.org.uk/uploads/2009-06-12-csd-final-report-2009bookmarked.pdf).

of the plan and for ensuring key wireless services are free from harmful interference. These responsibilities must be seen in the context of two guarantees given by the UK Government to the International Olympic Committee in support of London's bid for the Games. These guarantee the allocation of the spectrum required for the organisation of the Games and the waiving of fees otherwise payable for that spectrum by members of the Olympic Family.

- 3.46 On 19 October 2009, we published a statement setting out our spectrum plan for wireless communications at the London Games.<sup>26</sup> Use of wireless microphones and in-ear monitors (IEMs) at the Games is of most relevance to the digital dividend as they operate primarily in UHF Bands IV and V.
- 3.47 To maximise the supply of spectrum for wireless microphones and IEMs for the London Games, we will make the digital dividend available in London, deferring the start date for rights to use this spectrum until the Games have concluded. We will also develop venue-specific arrangements to ensure spectrum freed up by DSO is available for use for wireless microphones and IEMs at venues outside London, where the spectrum requirements will be much lower than at the London venues.

### Cognitive devices

- 3.48 We published a consultation on proposed parameters for licence-exempt cognitive devices using interleaved spectrum on 16 February 2009.<sup>27</sup> In a subsequent statement published on 1 July 2009,<sup>28</sup> we concluded cognitive devices should either sense the presence of other signals or make use of a geolocation database to determine which spectrum was unused in the vicinity. In that statement, we provisionally concluded on the parameters needed for sensing but noted further discussion would be needed as to how a geolocation database might operate.
- 3.49 On 17 November 2009, we published a discussion document that focused on geolocation and the mechanisms likely to be needed to make it work.<sup>29</sup> It was intended as input to the thinking on geolocation taking place around the world rather than as a statement of clear regulatory intent. It was hoped it would further discussion and speed the development of possible geolocation solutions. It did not seek to change in any way the decisions on general cognitive access and sensing set out in our July 2009 statement. The closing date for responses to the discussion document was 9 February 2010.

### Consultation on spectrum information

- 3.50 We published a consultation on providing spectrum information on 10 August 2009.<sup>30</sup> This outlined our proposals for providing information relating to the radio spectrum and discussed issues surrounding data disclosure. We proposed to release identified spectrum information in order to comply with legal requirements placed on us under the Environmental Information Regulations 2004 to progressively make environmental information available to the public by electronic means.<sup>31</sup> In addition, we sought views on proposals to make available additional information to further the interests of citizens and consumers. The consultation closed on 2 November 2009.

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<sup>26</sup> [www.ofcom.org.uk/consult/condocs/london2012/statement/statement.pdf](http://www.ofcom.org.uk/consult/condocs/london2012/statement/statement.pdf).

<sup>27</sup> [www.ofcom.org.uk/consult/condocs/cognitive/cognitive.pdf](http://www.ofcom.org.uk/consult/condocs/cognitive/cognitive.pdf).

<sup>28</sup> [www.ofcom.org.uk/consult/condocs/cognitive/statement/statement.pdf](http://www.ofcom.org.uk/consult/condocs/cognitive/statement/statement.pdf).

<sup>29</sup> [www.ofcom.org.uk/consult/condocs/cogaccess/cogaccess.pdf](http://www.ofcom.org.uk/consult/condocs/cogaccess/cogaccess.pdf).

<sup>30</sup> [www.ofcom.org.uk/consult/condocs/providing\\_spectrum\\_information/main.pdf](http://www.ofcom.org.uk/consult/condocs/providing_spectrum_information/main.pdf).

<sup>31</sup> [www.opsi.gov.uk/si/si2004/20043391.htm](http://www.opsi.gov.uk/si/si2004/20043391.htm).

We will publish a statement on the issues raised and, having taken into account responses to our proposals, the steps we will take.

## Section 4

# Availability, potential uses and approach to award

- 4.1 This section examines potential uses of the 600 MHz band and geographic interleaved spectrum, taking account of the spectrum that may be available for award and the conditions likely to attach to its use. We would like stakeholders' views on potential uses, in particular any not identified here, and how the spectrum might be packaged to facilitate use. We would also like views on any issues of particular relevance for the nations and regions of the UK.
- 4.2 We looked at potential uses of the digital dividend in the DDR and the consultations we published in summer 2008. In this section, we recap those uses along with further information provided by consultation responses and other sources. Our decision to clear the 800 MHz band has caused us to review our consultation proposals on the awards of the 600 MHz band and geographic interleaved spectrum. Understanding potential uses will help us to consider how best to make these available, in terms of packaging and award design.
- 4.3 This section also addresses our approach to awarding this spectrum in general and channel 36 in particular. Finally, it explains how information on potential uses will help us in designing the spectrum awards.

## Spectrum availability

- 4.4 The 600 MHz band and geographic interleaved spectrum become available for new use region by region as DSO progresses and will be available across the UK at its completion in late 2012. The exception is channel 36, which is already available UK-wide following the clearance of aeronautical radar in June 2009. Figure 3 sets out the DSO timetable. (Note: DSO in the Channel Islands is due to start in November 2010.)

Figure 3. DSO timetable by region (source: Digital UK)



## 600 MHz band

- 4.5 The 600 MHz band comprises 56 MHz – channels 31-37, 550-606 MHz – of contiguous spectrum that will be cleared of previous uses by the end of DSO. It will be available for use throughout the UK, although there are likely to be constraints on certain uses in some areas due to international agreements. New rights of use will begin with the end of DSO in 2012.
- 4.6 In our June 2009 statement on clearing the 800 MHz band, we noted PMSE users face significant changes in adjusting to the removal of their access to the cleared spectrum as well as the need to move from channel 69, notwithstanding the benefits afforded by channel 38 as its replacement. We do not underestimate the challenge, and one of our key objectives for future PMSE spectrum access is to avoid disrupting users' ability to provide services to citizens, consumers and business customers.
- 4.7 Given this and the fact no respondent to the consultation that preceded the 800 MHz statement argued to start new services in the 600 MHz band before the end of DSO, we decided:
- we will maintain PMSE access to channel 36 on 12 months' notice to cease. The prospects of new use of this channel ahead of the rest of the 600 MHz band suggest to us a continued need for different treatment of its temporary availability for PMSE (although see paragraphs 4.78-4.87); and
  - we will maintain PMSE access to the rest of the 600 MHz band (channels 31-35 and channel 37) until DSO is completed in the UK in late 2012.

## Geographic interleaved spectrum

- 4.8 The geographic interleaved spectrum we award will be located within channels 21-30 (470-550 MHz) and 39-60 (614-790 MHz). In our June 2008 consultation, we proposed a list of transmission sites with associated frequencies that were candidates for award. The sites are shown in table 1 and grouped as follows:
- the 25 sites (including those with existing RTSLs) listed in our December 2007 statement on our approach to awarding the digital dividend (nos. 1 to 25);
  - the remaining 46 sites of the 71 identified in the 30 November 2007 report by National Grid Wireless (NGW) (nos. 26 to 71);<sup>32</sup>
  - eight sites identified following a local-television stakeholder event held on 14 January 2008 (nos. 72 to 79);<sup>33</sup> and
  - two sites in respect of the Crown Dependencies (nos. 80 and 81).

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<sup>32</sup> [www.ofcom.org.uk/consult/condocs/ddr/statement/NGW1.pdf](http://www.ofcom.org.uk/consult/condocs/ddr/statement/NGW1.pdf).

<sup>33</sup> [www.ofcom.org.uk/radiocomms/ddr/events/localtv140108.pdf](http://www.ofcom.org.uk/radiocomms/ddr/events/localtv140108.pdf).

**Table 1. Indicative list of transmission sites and frequencies**

No.	Site	Indicative channels	Relevant area	No.	Site	Indicative channels	Relevant area
1	Caldbeck	21 + 48	Carlisle	42	Bristol Kings Weston	30	Bristol relay
2	Winter Hill	57, 56 + 60	Manchester/ Liverpool	43	Rosemarkie	52	Inverness
3	Wenvoe	30 + 51	Cardiff	44	Rosneath VP	48	Greenock
4	Mendip	55 + 59 <sup>34</sup>	Glastonbury/ Somerset	45	Knockmore	56	Elgin
5	Craigkelly	52 + 30	Edinburgh	46	Angus	48	Dundee
6	Black Hill	51 + 48	Glasgow	47	Durris	30	Aberdeen
7	Oxford	49 + 29	Oxford	48	Darvel	30	Ayr
8	Waltham	55 + 59	Leicester	49	Luton	45	Luton
9	Belmont	21 + 23	Grimsby/East Yorkshire	50	Olivers Mount	56	Scarborough
10	The Wrekin	48 + 29	Shrewsbury/ Telford	51	Sheffield	26	Sheffield
11	Ridge Hill	30 + 23	Ross-on-Wye/ Hereford	52	Nottingham	62	Nottingham
12	Emley Moor	45 + 56	Leeds	53	Kidderminster	56	Kidderminster
13	Sutton Coldfield	51 + 29	Birmingham	54	Lark Stoke	48	Stratford upon Avon
14	Sandy Heath	49 + 23	Bedfordshire	55	Brierley Hill	56	Greater Birmingham relay
15	Sudbury	49 + 57	Suffolk	56	Keighley	56	Keighley
16	Tacolneston	57 + 49	Norwich	57	Malvern	51	Malvern
17	Hannington	43 + 49	Basingstoke	58	Bromsgrove	29	Bromsgrove
18	Rowridge	29 + 30	Southampton/ Portsmouth	59	Fenton	29	Stoke on Trent
19	Crystal Palace	29 + 42	London	60	Poole	50	Poole
20	Heathfield	54 + 45	East Sussex	61	Guildford	54	Guildford
21	Dover	57 + 49	Dover	62	Hemel Hempstead	49	Hemel Hempstead
22	Bilsdale	24 + 21	Middlesbrough	63	Midhurst	46	West Sussex
23	Pontop Pike	56 + 51	Newcastle	64	Salisbury	49	Salisbury
24	Londonderry	22 + 52	Londonderry	65	Reigate	51	Reigate
25	Divis	30 + 56	Belfast	66	Whitehawk Hill	54	Brighton
26	Beacon Hill	49	Torquay	67	Tunbridge Wells	51	Tunbridge Wells
27	Stockland Hill	30	Honiton/Exeter	68	Bluebell Hill	56	Mid Kent
28	Huntshaw Cross	51	Barnstaple	69	Limavady	56	Northwest Northern Ireland
29	Plympton	49	Plymouth	70	Brougher Mountain	30	Omagh
30	Redruth	55	Cornwall	71	Fenham	30	Newcastle relay
31	Caradon Hill	30	Devon	72	Selkirk	56	Borders

<sup>34</sup> Some frequencies are currently expected to remain in use for DTT services for a temporary period after DSO at certain transmitters. This is anticipated to involve channel 59 at Mendip. It is anticipated these frequencies would be available for new use from May 2011.



No.	Site	Indicative channels	Relevant area	No.	Site	Indicative channels	Relevant area
32	Presely	30	Southwest Wales	73	Bressay	30	Shetland Islands
33	Carmel	52	Southwest Wales	74	Keelylang Hill	48	Orkney
34	Llanddona	51	Anglesey	75	Rumster Forest	52	Wick/ Thurso
35	Lancaster	30	Lancaster	76	Eitshal	30	Isle of Lewis
36	Saddleworth	43	Saddleworth	77	Tay Bridge	51	Dundee relay
37	Storeton	30	Birkenhead/ Liverpool	78	Perth	30	Perth
38	Pendle Forest	30	Burnley	79	Balgownie	51	Aberdeen relay
39	Moel y Parc	30	Northeast Wales	80	Isle of Man	51	Douglas
40	Kilvey Hill	30	Swansea	81	Guernsey and Jersey	48	Guernsey/ Jersey
41	Bristol Ilchester Crescent	51	Bristol relay				

4.9 We will need to reconsider the availability of these channels in light of the consequences of clearing the 800 MHz band. Clearly, channels 61-69 will no longer be available, though only Nottingham (channel 62) is directly affected by this. There will be indirect consequences of moving DTT below channel 61 because channels 21 to 60 will become more intensively used. This may reduce the availability of geographic interleaved spectrum for other services. The materiality of this impact will be highly dependent on the exact outcomes of international negotiations and the coordination and UK planning arrangements that will flow from them. We will not know the exact details of interleaved channels and locations that will be available for award until these negotiations are further advanced, probably later in 2010.

### Scotland

4.10 It is feasible to release more interleaved spectrum in Scotland with a small number of adjustments to the technical details of the DSO frequency plan while still meeting the post-DSO DTT coverage targets. We commissioned NGW and Arqiva to look at potential optimisation of interleaved spectrum in both Scotland and Northern Ireland as, in these areas, there seemed to be some scope for this.

4.11 NGW's study<sup>35</sup> (referred to above) indicated five channels (30, 48, 51, 52 and 56) would be lightly used in Scotland and could be cleared by revising the DSO plan for one main transmission site (Rumster Forest) and nine relays. In light of this, we authorised the broadcasters to proceed with a revised DSO plan in Scotland for the relay transmitters.

4.12 Given the current international negotiations on clearing the 800 MHz band, it is now less clear which and how many channels might be cleared across Scotland. Our provisional view is the relative abundance of spectrum in Scotland and its geographic distance from neighbouring countries means it is likely the revised DSO plan will still deliver a number of channels cleared across Scotland.

<sup>35</sup> <http://www.ofcom.org.uk/consult/condocs/ddrinterleaved/reports/scot.pdf>

## Northern Ireland

- 4.13 Arqiva carried out a similar study in late 2007 looking into optimisation of the interleaved spectrum in Northern Ireland.<sup>36</sup> This showed it was possible at that time to find channels for an additional DTT multiplex to be broadcast at each of the main stations in Northern Ireland. The multiplex would have reasonable coverage provided a robust transmission mode was used. However, this work predated more recent spectrum-planning work, including work on clearing the 800 MHz band. As mentioned above, we probably will not know the exact details of interleaved channels and locations that will be available for award until later in 2010. As mentioned in paragraphs 3.15-3.17, the Government has indicated it may direct us on the use of some such spectrum in Northern Ireland. Bearing this in mind, we are endeavouring to identify additional frequencies in the interleaved spectrum that might be suitable for other uses, such as local television.

## Wales

- 4.14 The scope for optimising spectrum availability in Wales is much more limited. Due to its geography and population distribution, it takes almost the same number of transmission sites (and thus frequencies) to cover Wales as it does to cover Scotland, which has four times the land area and twice the population. Transmissions in Wales are also susceptible to interference with the Republic of Ireland in the west and with England in the north, east and south. The interleaved spectrum therefore will be very intensively used by existing DTT services in Wales after DSO, with relatively little white space remaining. In addition, DSO has already started in Wales, and it would be very costly to replace transmission equipment. We therefore do not consider it would be practicable to re-examine the availability of interleaved spectrum in Wales.

## England

- 4.15 The situation in England is similar to that in Wales. There are too many internal and external interactions for significant additional spectrum efficiency to be realised through changes to the DSO plan. Again, DSO has already started in various English regions.

## Position of the Crown Dependencies

- 4.16 We may make spectrum available for award in Guernsey, the Isle of Man and Jersey but the process for any award of that spectrum will be a matter for the respective administrations of those Crown Dependencies.

## **Technical licence conditions and relevance to potential uses**

- 4.17 In our June 2008 consultations, we took different approaches to the technical licence conditions (TLCs) for the cleared and geographic interleaved awards.

## **Cleared spectrum**

- 4.18 The TLCs we proposed for the cleared award are particularly relevant to the 600 MHz band, which formed part of the spectrum for that award. Our research showed there were a wide variety of potential uses for the cleared spectrum. The most likely included mobile television, mobile broadband (including two-way mobile services)

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<sup>36</sup> [www.ofcom.org.uk/consult/condocs/ddrinterleaved/reports/arqiva.pdf](http://www.ofcom.org.uk/consult/condocs/ddrinterleaved/reports/arqiva.pdf).

and DTT (in both SD and HD). It was not clear which mixture of specific services or technologies would be deployed in different frequencies, when different deployments would occur and the extent of any future changes to technologies or deployments. This meant there was significant uncertainty over the nature of transmissions. Given this degree of uncertainty, our preference was to specify the TLCs for the award in terms of spectrum-usage rights (SURs). The reasons were as follows.

- Licensees with this type of TLC are directly limited in respect of the interference they are permitted to cause to other services in neighbouring channels. Licence holders are therefore incentivised to comply with this constraint by efficiently optimising the trade-off between transmitter density and transmitter power. Because of the large and uncertain range of transmission-network power and density combinations that could be deployed to use this spectrum, we believed SURs were a better mechanism with which to control interference efficiently and flexibly than a transmit-mask approach.
- As SURs are specified in terms of the interference experienced by neighbouring licensees, they provide more certainty to these neighbours over expected interference levels. This enables potential bidders in an auction (and traders in the secondary market) to make a more accurate evaluation of the opportunities to use the spectrum for different purposes. Accordingly, the greater level of certainty over incoming interference that SURs can provide is likely to promote a more efficient allocation outcome from an auction. In addition, SURs make subsequent negotiations between different licensees over the use of guard bands between them a simpler process as the adjacent licensees concerned have a better awareness of the interference they are permitted to cause to and expect from neighbours.

4.19 Many – though not all – responses to our June 2008 consultation recognised SURs offered a flexible approach, though there was some concern that detailed aspects were not clear enough. For more information on SURs, see our statement of 14 December 2007,<sup>37</sup> in particular paragraphs 5.5-5.29.

4.20 We recognised there might be situations where there was a case for the affected licensees to request changes in the relevant TLCs (e.g. if the award outcome resulted in one of the bands being awarded for use by the same type of transmission network). Such requests could, in principle, include proposing TLCs using a transmit-mask approach. Given the proposed timing of the award at that time relative to when transmissions might commence, there might have been an opportunity to complete the consideration of any such requests before networks were deployed.

## Geographic interleaved spectrum

4.21 For licences to be awarded for geographic interleaved spectrum, we proposed to include TLCs designed to protect the existing DTT multiplexes from harmful interference from new services after DSO. Since we saw provision of DTT as the most likely use of the spectrum, we proposed to include TLCs appropriate to that service.

4.22 The TLCs were designed to protect the best DTT coverage,<sup>38</sup> regional and national ITV services and where aerials were directed for analogue reception in a location.

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<sup>37</sup> [www.ofcom.org.uk/consult/condocs/surfurtherinfo/statement/statement.pdf](http://www.ofcom.org.uk/consult/condocs/surfurtherinfo/statement/statement.pdf).

<sup>38</sup> The best DTT coverage is one that offers the viewers in an area services from all three PSB multiplexes plus the greatest number of the three commercial multiplexes.

They would define a number of technical parameters for a given channel at a particular transmission site, including:

- the frequency;
- the maximum radiated power that may be used;
- the transmit antenna template (modified as required by any international coordination restraints that apply);
- the polarisation (horizontal or vertical); and
- the height of the transmit antenna on the mast.

4.23 The TLCs would also include a transmit mask based on the appropriate DVB-T mask specified in UK Interface Requirement 2022 (IR2022).<sup>39</sup> We included these TLCs in the licences awarded in February 2009 for Manchester and Cardiff.

4.24 In response to our June 2008 consultation, organisations associated with broadcasting were generally content with the proposed TLCs. A number of responses from others commented on their applicability to non-DTT use. We recognise these TLCs would be less suitable for new non-DTT services. Where the spectrum is not used for DTT, it is likely multiple transmitters will be deployed to form a network. In that case, we would favour including SURs as TLCs. If, after award, the licensee wished to provide other services, we would consider any request for variation of the TLCs.

### Protecting existing DTT

4.25 The protection of existing DTT services from out-of-band harmful interference from new services is an important factor in successfully delivering DSO and in particular making the public-service broadcasters' multiplexes available on a near-universal basis across the UK. We therefore proposed in our June 2008 consultation on the cleared award to include a 'protection clause' in licences to protect existing DTT services. This clause would explicitly refer to the detailed coverage/channel plan of the DTT network after DSO. It would give certainty to the existing DTT broadcasters that planned receivers of their services would receive a defined level of protection and to new licensees about the levels of interference they would be permitted to generate. Including such a clause would avoid the need for large UK-wide guard bands to be placed between fixed transmitters using cleared spectrum and the frequencies used by broadcasters in the incumbent DTT network and for overly restrictive emission levels to be specified on a UK-wide basis.

4.26 Most responses to our consultation supported our proposal for a protection clause that would be applied, as a licence obligation, to all new services and agreed we should engage with stakeholders to finalise this approach. An initial stakeholder meeting in September 2008 agreed we would need to develop our proposals in more detail for a subsequent meeting. Developing the proposals is a complex technical and economic task we are taking forward in the context of the 800 MHz award. We expect to engage further with stakeholders on this issue in the spring. If you would

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<sup>39</sup> [www.ofcom.org.uk/radiocomms/ifi/tech/interface\\_req/ir2022.pdf](http://www.ofcom.org.uk/radiocomms/ifi/tech/interface_req/ir2022.pdf). It is expected this document will be revised during 2010 to accommodate some recent developments including the clearance of channels 61 and 62 and the retention of channels 39 and 40 for DTT instead.

like to ensure we contact you when further details are available, please email [reuben.braddock@ofcom.org.uk](mailto:reuben.braddock@ofcom.org.uk).

- 4.27 In the June 2008 consultation on the geographic interleaved awards, we considered applying the protection clause to new services using this spectrum. We did not propose to apply it where a new DTT transmitter was expected to be co-located at the transmitter site of an existing DTT service. We considered there would be no material impact on reception of existing DTT transmissions from that site on the basis viewers would wish to use their existing TV aerial, which would be pointing in the direction of the site. Similarly, the impact of new local television services on existing DTT reception from other transmitter sites would be limited in accordance with a tightly defined set of planning rules. Where non-DTT or non-co-located DTT services were to use the spectrum, we said it might be appropriate to apply the protection clause because it might be more difficult to determine the impact on existing DTT services.
- 4.28 On further consideration, we believe it might be appropriate to apply the protection clause consistently to all new licences for both the 600 MHz band and geographic interleaved spectrum, including new DTT services. This is because some new DTT services might not originate from existing DTT sites. Also, it would facilitate subsequent change of use or trading of a licence.

*Question 1: Do you have any comments on the application of the protection clause to all new licences for the 600 MHz band and geographic interleaved spectrum?*

- 4.29 While a general obligation in the form described above is of particular benefit in cases where the new licensee can plan a fixed, compliant transmission network in advance, we believe it is less effective at dealing with the generally transitory nature of mobile transmissions where exact transmission densities are not under the day-to-day control of the licensee. These can make the exact diagnosis of particular interference problems (e.g. those caused by mobile handsets moving past a house) difficult.
- 4.30 In addition to the protection clause outlined above, we therefore proposed further measures were required to protect DTT receivers from mobile transmitters, in the form of a minimum separation between the frequencies used. Our provisional view is that a guard band of at least 8 MHz would be desirable to protect DTT from mobile services using the 600 MHz band. Larger separations could emerge from the award if other types of use of the spectrum (e.g. uplink transmissions using frequency-division duplexing – FDD) were successful.

*Question 2: Do you have any comments on our approach to technical licence conditions for the 600 MHz band and for geographic interleaved spectrum?*

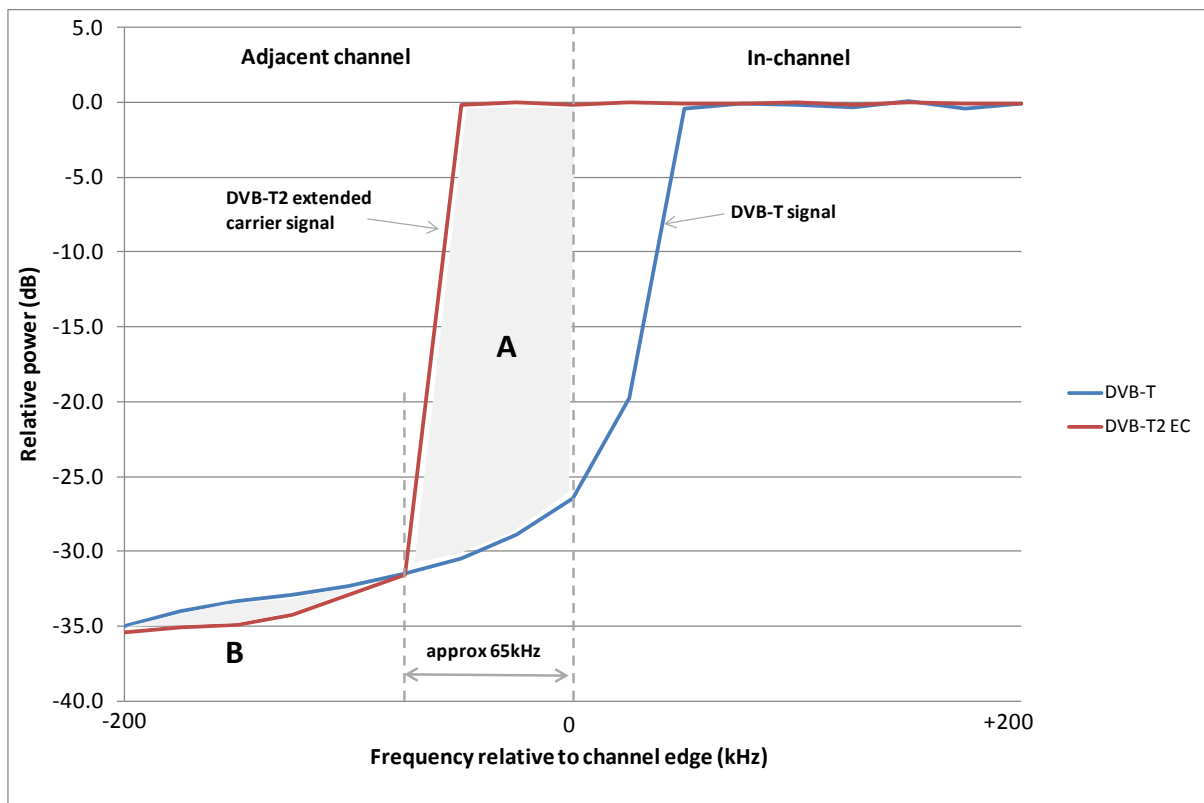
## **Frequency offsets and extended-carrier mode**

- 4.31 Multiplex operators usually make a small adjustment to the centre frequency of a DTT signal to move it away from a band edge or another DTT signal in an adjacent channel. The result is to slightly offset the DTT signal either up or down in frequency within its 8 MHz channel. By convention, the value of the offset is 167 kHz.
- 4.32 Operators' plans for DSO include making use of frequency offsets on all six multiplexes. The first regions have already switched over with transmitters operating on that basis, and equipment has already been installed or procured for many sites switching in 2010. With the launch of DVB-T2 services, multiplex operators are keen

to make use of the maximum possibilities the newer standard incorporates, including extended-carrier (EC) mode. This increases data capacity by approximately 2% (equating to around 900 kbs, about the same as is required to accommodate the surround sound for two HD services) but reduces the gap to the channel edge to 115 kHz. Annex 5 has further information on DVB-T2 and frequency offsets.

- 4.33 Combining frequency offsets and EC mode will result in the wanted part of the DVB-T2 signal overlapping the adjacent channel by 52 kHz. As there is currently no immediate impact on the use of adjacent spectrum, the BBC (the only multiplex operator currently using DVB-T2) has been granted a temporary licence to operate in this manner while we consider whether to permit such overlaps to remain in the longer term as part of a wider review of IR2022.
- 4.34 Figure 4 shows 400 kHz in the immediate vicinity of a channel edge and illustrates the amount of energy put into the lower adjacent channel by a DVB-T signal (in blue) and a DVB-T2 EC signal (in red), both of which have been offset by -167 kHz. There is clearly a change in the amount of energy put into the adjacent channel. In area A, the DVB-T2 signal puts more energy into the channel than the DVB-T signal, while the reverse is true in area B. The overall increase in the amount of energy put into the adjacent channel is approximately 3 dB when compared with DVB-T, although the majority of the additional energy would be concentrated within 65 kHz of the channel boundary.

**Figure 4. DVB-T and DVB-T2 EC signals with a negative frequency offset**



Consequences of not permitting DVB-T2 EC multiplexes to use frequency offsets

- 4.35 If the overlap is not permitted, the BBC would have three principal choices:

- cease using EC mode. There would be a consequential loss of the 2% of multiplex capacity. A reduction of this magnitude would not present an immediate problem to carrying three HD services within a multiplex, but a loss of capacity could at the margins introduce delays in adding fourth and fifth HD services;
- continue using EC mode and discontinue using offsets. The broadcasters and transmission companies would need to amend their plans for equipment procurement to include more stringent filtering requirements. Some retuning or replacement of equipment at transmitters that have completed DSO would be required. The costs have not yet been quantified but are likely to be considerable, probably amounting to at least some millions of pounds, and would affect all multiplex operators, not just the BBC; or
- use a smaller value of offset. Using a smaller offset (e.g. 100 kHz) would keep the DVB-T2 EC signal within its channel. However, this would be a departure from the long-established industry standard of 167 kHz and have a knock-on effect on receiver design and testing. A smaller offset is only a partial solution as some changes would still need to be made to existing transmitters and equipment already installed.

4.36 Of the three options, ceasing using EC mode carries the lowest cost and risk to DSO.

#### Consequences of permitting DVB-T2 EC multiplexes to use frequency offsets

4.37 We are considering what the impact of permitting the overlap from a DVB-T2 signal into an adjacent channel might be. We have looked at both the cleared and interleaved spectrum, and our preliminary conclusions are as set out below.

- Use of cleared spectrum – the convention adopted by multiplex operators is to offset DVB-T signals away from band edges (i.e. in channels 21, 30, 39 and 60). A DVB-T2 signal offset away from a band edge does not put any more energy into the adjacent cleared channel. There is therefore expected to be no impact on the use of the cleared spectrum should the use of DVB-T2 EC and frequency offsets be permitted.
- Additional multiplexes in geographic interleaved spectrum – the existing multiplex operators cooperate over the use of frequency offsets. Where one multiplex is offset (perhaps due to proximity to a band edge), any adjacent multiplexes are also offset by agreement, and a UK implementation plan has been developed on that basis. There is therefore no expected impact on the existing multiplexes should this convention continue with DVB-T2 EC services.

The same should generally hold true for additional multiplexes that use geographic interleaved spectrum. There may, however, be a limited number of occasions where an offset DVB-T2 signal could have an impact on the use of the adjacent channel (e.g. where the adjacent channel is a 'sandwich' channel bounded by two signals that are offset toward it). In many cases, these channels will already be unsuitable for DTT use due to potential interference either to or from other transmitters. We will nevertheless look in more detail at the potential impact on additional multiplexes in geographic interleaved spectrum.

- Non-DTT use of interleaved spectrum – it is more difficult to predict the impact of a small amount of DVB-T2 overlap on non-DTT uses of adjacent interleaved spectrum. Some existing uses (e.g. PMSE) are well understood, while others (e.g. cognitive devices) are less well defined.

For known uses, it is likely the limiting factor on the use of spectrum adjacent to a multiplex will be the filtering within the devices themselves that determines their adjacent-channel performance. For PMSE users, a minimum guard band of a few hundred kilohertz between them and any high-power DTT use (whether DVB-T or -T2) will be required. The presence of the overlap itself is unlikely to have any material impact. It is our preliminary view the same is likely to be true of cognitive devices.

- 4.38 Our initial conclusion is that permitting a small overlap would have little effect on current or known potential users of the adjacent spectrum. However, before we come to a final decision, we are seeking views on the likely impact permitting such an overlap might have on both established and new uses.

*Question 3: Do you have any evidence using frequency offsets with DVB-T2 EC signals might have an adverse impact on uses of adjacent interleaved spectrum?*

### Interference into cable television

- 4.39 New mobile services, principally mobile handsets, using UHF Bands IV and V might cause harmful interference into cable networks, cable set-top boxes and other devices such as games consoles. The potential extent of this problem and possible mitigation strategies have been raised at a European level in connection with the 800 MHz band and are the subject of ongoing discussions with key stakeholders including the Government and EU partners. But it may arise equally where mobile services operate in the 600 MHz band and geographic interleaved spectrum.

*Question 4: Do you have any evidence mobile services using the 600 MHz band and geographic interleaved spectrum could cause harmful interference to cable television?*

### Protecting PMSE in channel 38

- 4.40 As mentioned in paragraph 3.3, we have made channel 38 available for PMSE as a consequence of our decision to clear it from channel 69. We believe the TLCs we apply to use of the 600 MHz band should afford PMSE users of channel 38 a level of protection from harmful interference equivalent to that of channel 69 from adjacent terrestrial television. We will consider further the implications for programme-link services that may be more susceptible to harmful interference from some types of possible future use of the 600 MHz band. We will also consider any interference implications of PMSE into such services.

*Question 5: Do you have any comments on protecting PMSE in channel 38?*

### Non-technical licence conditions and relevance to potential uses

- 4.41 In the June 2008 consultations, we proposed to include a number of non-technical conditions in the licences to be awarded. In particular, we proposed:
- DTT multiplex issues – to include certain restrictions on ownership in relation to use of the spectrum to operate new DTT multiplexes. These would be similar to those under the Broadcasting Act 1996<sup>40</sup> but not extend to broadcasting bodies (given BBC Free to View already holds a Broadcasting Act licence for Multiplex B and is directly under the control of the BBC) or advertising agencies (as all

<sup>40</sup> [www.opsi.gov.uk/acts/acts1996/Ukpga\\_19960055\\_en\\_1](http://www.opsi.gov.uk/acts/acts1996/Ukpga_19960055_en_1).



content restrictions in relation to advertising would apply in any event via the regulation of content);

- DTT multiplex issues – to facilitate technical interoperability between any new and existing DTT services;
- spectrum trading – licences would be tradable. All types of trade – partial or total, concurrent or outright – would be permitted;
- licence duration – the licences would be of indefinite duration with an initial term ending in 2026.<sup>41</sup> The licence fee for the initial term would be set through the award processes, but we expected to charge further fees after the initial term. Our power to revoke the licences on spectrum-management grounds would be limited during the initial term;
- no restrictions on uses – the licences would not contain any restrictions on the use to which the spectrum could be put, subject to complying with licence conditions; and
- providing information – licensees would be required to provide certain information regarding their use of the spectrum, which we might publish to facilitate spectrum trading.

4.42 Responses to those consultations mainly covered DTT multiplex issues and the provision of information. Many agreed with our proposals on ownership restrictions, though there was some concern about opening up the spectrum to advertising agencies. On interoperability, there were three distinct camps: those who favoured our proposal to facilitate it; those who wanted it mandated in new licences; and those who wanted it left to commercial agreement. Most responses agreed with including an information provision to facilitate spectrum trading, with some comments on limiting the information requested and the effectiveness of such a provision.

4.43 In the past year, we have consulted on two subjects that have a bearing on some of these conditions: media ownership rules and spectrum information. Section 3 provides details of these consultations. Our conclusions in our review of the media-ownership rules do not affect our position on who may hold licences for the 600 MHz band and geographic spectrum to operate new DTT services. We will take into account the outcome of the spectrum information consultation in considering whether the licence condition on providing information should be modified.

4.44 We included non-technical conditions on the above lines in the licences awarded in February 2009 for geographic interleaved spectrum in Manchester and Cardiff. We propose to maintain the same conditions for the 600 MHz band and future geographic interleaved spectrum but are interested in stakeholders' views on this. We will take these into account in finalising details of the awards for subsequent consultation.

*Question 6: Do you have any comments on non-technical licence issues and the way we propose to approach them?*

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<sup>41</sup> We set the end of the initial term at 2026 to synchronise with the end of the renewed term of three of the existing DTT multiplex licences (i.e. 12 years from 2014). This could enable a comprehensive assessment of the efficient use of UHF Bands IV and V at that time.

## Potential uses

- 4.45 In preparing our June 2008 consultations, we commissioned further focused stakeholder research to understand the services potential users of the spectrum wished to provide given the pace of change in wireless communications markets. We set out our assessments of the likely uses of the cleared and geographic interleaved spectrum in those consultations. These were:
- new DTT channels in either SD or HD aimed at a UK market;
  - new DTT channels aimed at national, regional or local markets;
  - mobile television;
  - mobile broadband (including two-way mobile services);
  - PMSE; and
  - communications for the emergency services.
- 4.46 Responses broadly agreed with our assessment. It appears the most likely uses of the 600 MHz band are DTT and mobile broadband. Most responses to the geographic interleaved consultation agreed DTT was the most likely use.
- 4.47 Information on likely uses is very important to us in deciding what TLCs will be needed to facilitate the coexistence of different types of transmission and receiver network. It is also fundamental to our definition of spectrum packages for award.
- 4.48 Table 2 summarises the views provided by stakeholders on the quantity of spectrum they would require for the most likely uses of the cleared and geographic interleaved spectrum.

**Table 2. Summary of stakeholder views on spectrum requirements**

Use	Likely spectrum requirement per operator
DTT: UK-wide (SD and HD)	8 to 48 MHz cleared
DTT: national/regional/local	8 to 16 MHz interleaved in each area
Mobile television	8 to 24 MHz cleared
Mobile broadband	10 to 48 MHz cleared
PMSE	8 MHz cleared/interleaved

- 4.49 These and other potential uses of the 600 MHz band and geographic interleaved spectrum are considered below.

### DTT

- 4.50 Terrestrial television in the UK is broadcast using spectrum in UHF Bands IV and V. The current broadcasting infrastructure comprises 80 medium to high power transmission sites and over 1,000 low to medium power relay transmission sites distributed throughout the UK. The main transmission sites are generally high power, located on high tower sites and cover large geographic areas (typically 60 km radius) with high population. The relays generally operate at medium to low power using shorter masts, with coverage ranging from towns and cities to small communities.

- 4.51 The DTT signal (called a multiplex) is a flexible mechanism for delivering a range of content to viewers with suitable receivers. The existing multiplexes have for some time been broadcasting a range of SD television content as well as radio and interactive services. These have recently been joined by HD television services that have commenced broadcasting in some areas and are due to become available across the whole of the UK by the completion of DSO.
- 4.52 A combination of two technical developments has made DTT HD services a practical proposition. The first is the new transmission signal DVB-T2, which provides multiplexes with around a 50 to 60% increase in data capacity over the DVB-T standard used for some time in the UK. The other is an advanced video-encoding standard called MPEG-4 that makes more efficient use of the data capacity within a multiplex. Viewers will need new equipment to receive services using these new standards, and we expect the first products to become available in early 2010.
- 4.53 Operators of new DTT multiplexes would therefore have a choice of technical parameters allowing them to tailor their service to particular markets. For example, a local-television operator planning to broadcast a single service may choose a robust signal mode that maximises coverage for a modest transmitter power. Equally, a high-capacity multiplex using the latest encoding technology could carry three to five HD services or around 15 to 20 SD services. Many possibilities lie in between these examples.
- 4.54 One or two new DTT multiplexes in the 600 MHz band operating with DVB-T2 and MPEG-4 would not only be able to offer a wide range of new services but could also facilitate the transition to these new technologies of existing multiplexes. Only one of the current DTT multiplexes operates with DVB-T2 and MPEG-4; the remaining five could convert to these new technologies but at the cost of disrupting their existing services. Their conversion to DVB-T2 and MPEG-4 could be accelerated directly by using the 600 MHz band or indirectly by the more widespread availability of appropriate receivers that would follow from the use of these technologies to develop new DTT services in the band.
- 4.55 Our June 2008 consultation on the cleared award set out how cleared spectrum (including the 600 MHz band) could be used for DTT. Our June 2008 consultation on the geographic interleaved awards noted DTT was the most likely use of the spectrum and aggregating 71 large and medium lots could cover approximately 53% of UK households using 64QAM modulation, with capacity for eight or nine video streams, or 76% using QPSK modulation, with capacity for three video streams.
- 4.56 As the 600 MHz band and geographic interleaved spectrum are both suitable for DTT, there is the possibility for interested parties to combine the two types of spectrum to optimise or refine DTT coverage. The current international negotiations on clearing the 800 MHz band mean there is now less certainty about the extent to which geographic interleaved spectrum will be available, so at this stage it is less clear what coverage might be achieved by aggregation. But we still expect there to be significant availability of geographic interleaved spectrum following the negotiations.
- 4.57 We briefly illustrate below some possibilities for coverage and combinations, focusing at the level of:
- the UK as a whole;
  - the nations and regions; and

- locally.

### UK-wide

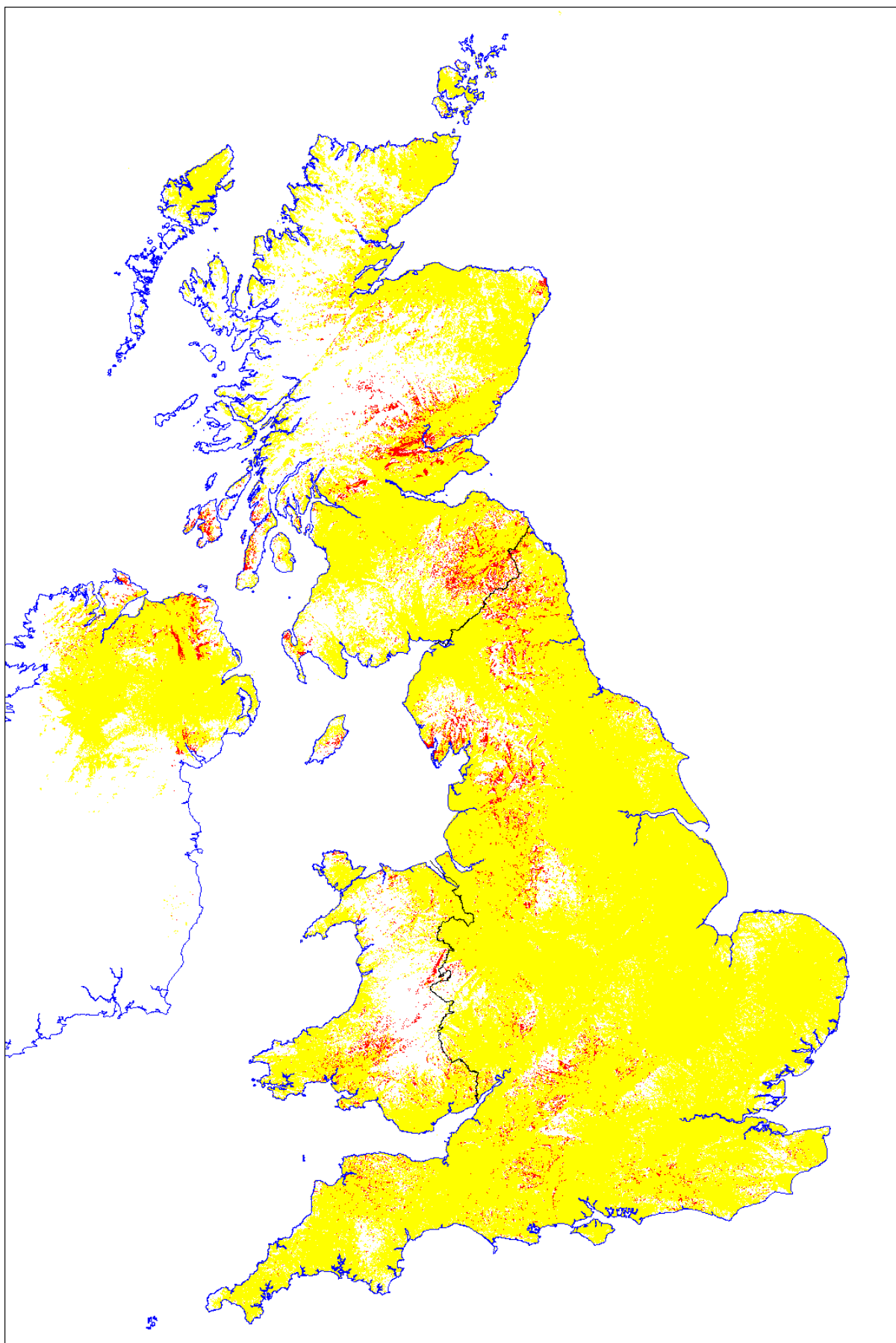
- 4.58 The original DSO plan would have resulted in the use channels 41-62 for DTT. Under the Geneva 2006 agreement (GE06),<sup>42</sup> this arrangement enabled the creation of the current six DTT multiplexes that together carry the channels broadcast on the Freeview platform. GE06 also permitted the creation of at least a further two multiplexes using the cleared spectrum.
- 4.59 In anticipation of revisions to the pattern of DTT use following our decision to clear the 800 MHz band, we asked Arqiva to consider how two multiplexes (or 'layers') could be accommodated in the 600 MHz band. In March 2009, Arqiva produced its first study of this issue,<sup>43</sup> modelling how, in principle, six channels in the band might be used. Layer 7 was modelled using channels 31 to 33, layer 8 using channels 34, 35 and 37. The modelling necessarily used a range of assumptions, including:
- a view on the potential impact of neighbouring countries' clearance of the 800 MHz band;
  - omitting the effect of constraints on spectrum use that could result from international coordination, self-interference and any infrastructure limitations;
  - use of a 64QAM modulation scheme;
  - the effect of channels that may be out of group (i.e. incompatible with household aerials); and
  - a notional network of 97 transmitters – the 80 main transmitters used by the commercial multiplexes plus 17 of the larger relays.
- 4.60 The study's provisional assessment was that layers 7 and 8 could achieve gross coverage of around 91% of UK households to grouped aerials (or 1 to 2% higher if wideband aerials were used in some areas). Each layer might have a capacity of up to eight video streams. Arqiva noted the restrictions imposed by transmission infrastructure and those likely to result from coordination would result in a reduction in coverage or capacity in reality.
- 4.61 Figures 5 and 6 provide a comparison of layer 7 and 8 coverage to wideband aerials (the situation normally modelled) and coverage assuming grouped aerials. Note that in the areas coloured yellow, coverage remains the same whether a wideband or grouped aerial is used. In the red areas, coverage is lost if a grouped aerial is used.

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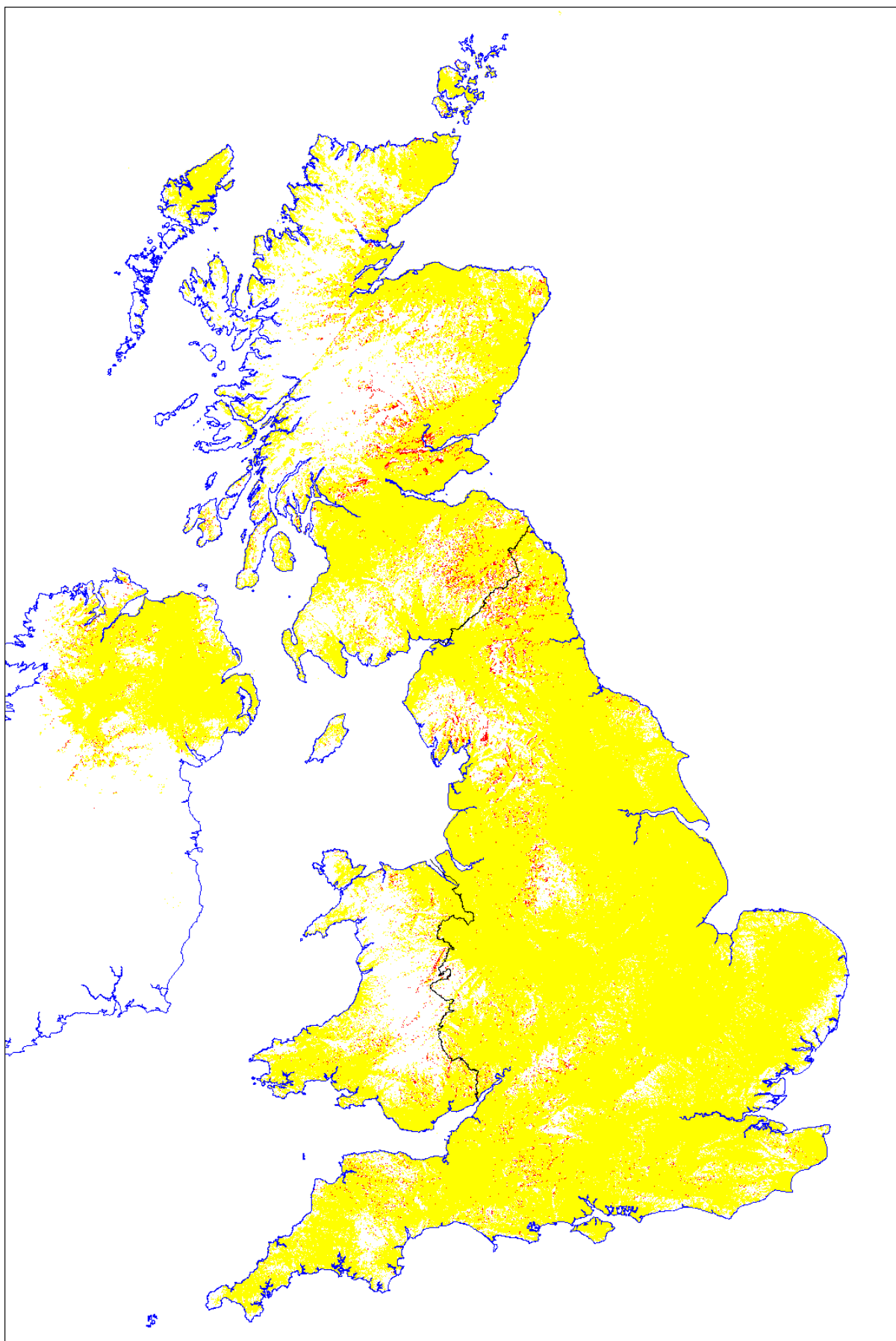
<sup>42</sup> GE06 has the status of an international treaty and was agreed at a Regional Radio Conference covering Europe, the Middle East and Africa held under the auspices of the International Telecommunication Union in Geneva in 2006.

<sup>43</sup> <http://www.ofcom.org.uk/radiocomms/ddr/documents/ch21.pdf>

**Figure 5. Comparison of layer 7 coverage between wideband and grouped aeri**



**Figure 6. Comparison of layer 8 coverage between wideband and grouped aeriels**



- 4.62 The Arqiva study is purely illustrative and intentionally focused on channels in the 600 MHz band. Many other combinations and applications may be possible, including aggregating 600 MHz and geographic interleaved spectrum to create particular coverage patterns, including of a particular nation or region.

### Nations and regions

- 4.63 A multiplex operator interested in forming a sub-UK-wide multiplex or a multiplex covering Northern Ireland, Scotland, Wales or an English region could use an appropriate portion of the 600 MHz band or aggregate lots of geographic interleaved spectrum. Alternatively, such a multiplex might be formed using 600 MHz spectrum supplemented where appropriate by geographic interleaved spectrum where this enhanced coverage because, for example, it was compatible with household aerials.

### *Scotland*

- 4.64 Optimising interleaved spectrum in Scotland would give higher coverage than the straightforward aggregation of Scottish geographic interleaved lots (the NGW study referred to in paragraph 4.11 shows this). In light of this and responses to our June 2008 consultation on the geographic interleaved awards, we authorised Digital UK to proceed with a revised DSO plan in Scotland. If the five optimised channels were used for two additional new DTT multiplexes, coverage could be as shown in table 2 (assuming 64QAM). Note these coverage predictions are just examples of what could be done with the optimised spectrum. They also depend on the outcome of the international negotiations on clearing the 800 MHz band. Our provisional view is the relative abundance of spectrum in Scotland and its geographic distance from neighbouring countries makes it likely the revised DSO plan will still deliver a number of channels cleared across Scotland.

**Table 2. Potential coverage from optimising interleaved spectrum in Scotland**

<b>Multiplex</b>	<b>Coverage of Scotland (households)</b>	<b>Notes</b>
First additional	84%	Using 15 transmission sites
Second additional	52%	Using Black Hill and Craigkelly only (i.e. covers Glasgow and Edinburgh)

### *Northern Ireland*

- 4.65 Our June 2008 consultation also noted it might be possible to optimise interleaved spectrum in Northern Ireland and so improve coverage there. However, as with Scotland, we will not know the exact details of the geographic interleaved spectrum available for award until the conclusion of the international negotiations on clearing the 800 MHz band. Also, we will have to find suitable spectrum in line with any direction by the Government to establish a multiplex to carry Irish television services from the three Northern Ireland main transmitters.

### Local television

- 4.66 Local television is, by definition, aimed at serving relatively small geographic areas that are likely to be more tightly defined than the current regional and sub-regional services of ITV and the BBC (e.g. a city, a local-authority district or a smaller location such as a neighbourhood or housing estate). The geographic interleaved spectrum is well suited to supporting such services. In our December 2007 statement on our

approach to awarding the digital dividend, we concluded demand for interleaved spectrum to provide local television could best be enabled – without precluding other, potentially more valuable services – by identifying and awarding suitably designed lots, each providing coverage of a defined area. Separate (and not necessarily contiguous) geographic interleaved spectrum could be aggregated to form a network of local-television stations. An aggregated multiplex might also provide additional opportunities for local television or other operators to negotiate access to a video stream. But it would also be suitable for other non-local or geographic services based on a location significantly broader than a local area.

- 4.67 Most responses to our June 2008 consultation agreed DTT was the most likely use of the geographic interleaved spectrum. Local-television stakeholders argued it would provide local stations with a visibility difficult to achieve through other platforms and so create critical mass for the local-television sector. We recognise the significant interest they continue to show in developing local television on DTT and will take this into account in developing proposals for spectrum packaging and award design.

### **Mobile television**

- 4.68 A number of respondents to our consultation of 19 December 2006 on our proposed approach to the award of the digital dividend<sup>44</sup> highlighted channel 36 would be particularly suited to mobile television. The channel has been used primarily for aeronautical radar, which, as mentioned in paragraph 3.13, has now been cleared. We discuss its potential use for mobile television in paragraphs 4.78-4.87.

### **Mobile broadband**

- 4.69 In our December 2007 statement on our approach to awarding the digital dividend, we noted cleared spectrum could be used for established or new mobile communications services for both data and voice. Because signals at these frequencies can travel relatively long distances, large areas can be covered at lower cost than using higher-frequency bands, so cleared spectrum might be one of the more cost-effective means of delivering mobile services in rural areas. Lower frequencies generally penetrate buildings better than higher frequencies, so cleared spectrum might also be useful in urban and suburban areas for in-building coverage.
- 4.70 The suitability of this spectrum for mobile broadband has led an increasing number of European countries to identify the 800 MHz band as their digital dividend. Similar services could, of course, be accommodated in other spectrum, including the 600 MHz band and geographic interleaved spectrum. However, we are not aware of any immediate prospect of this beyond the UK, and this may affect the commercial case for mobile-broadband use of these bands.
- 4.71 Moreover, the operation of mobile-broadband services in geographic interleaved spectrum is uncertain. But if it is feasible – particularly for downlinks (i.e. from base stations to mobile receivers) – geographic interleaved lots could provide new or extended access on a sub-UK basis (e.g. in areas not served by fixed lines or existing wireless networks using higher frequencies).
- 4.72 We have done some work on how mobile communications networks might use the 600 MHz band. This has looked at systems using FDD and time-division duplexing (TDD) and a mixture of the two. Examples of some possibilities – which also include scope for PMSE use – are illustrated in figures 7-9. (Note: DL2 denotes the downlink

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<sup>44</sup> [www.ofcom.org.uk/consult/condocs/ddr/ddrmain.pdf](http://www.ofcom.org.uk/consult/condocs/ddr/ddrmain.pdf).



channel of an FDD system and UL1 the corresponding uplink. Guard bands are coloured grey and white.)

Figure 7. Illustrative band plan: FDD centric

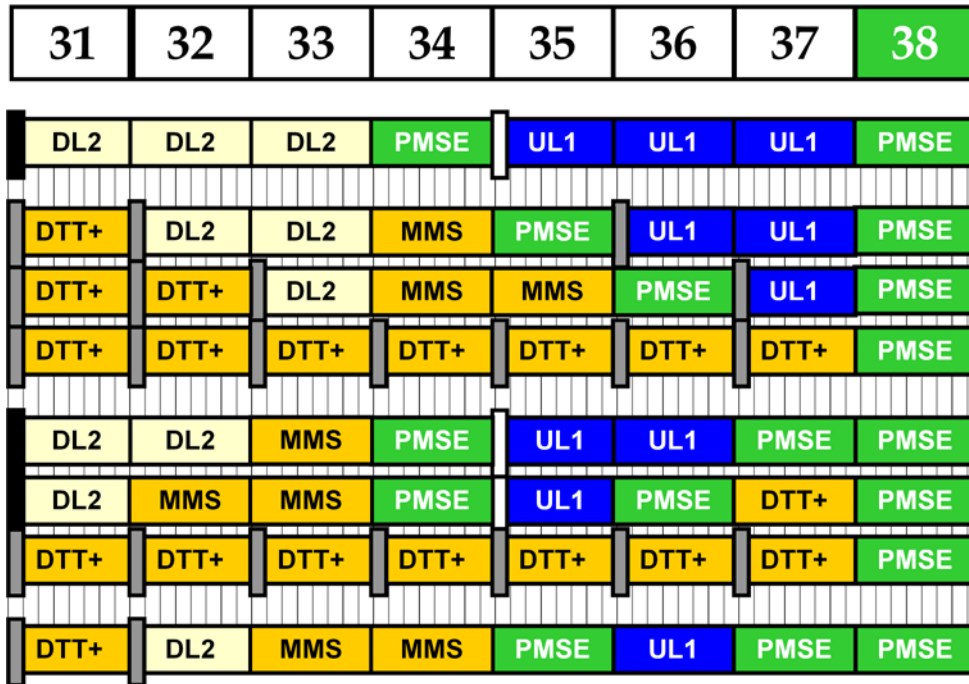


Figure 8. Illustrative band plan: TDD centric



**Figure 9. Illustrative band plan: mixed FDD and TDD**

31	32	33	34	35	36	37	38
DL2	DL2	DL2	PMSE	UL1	UL1	UL1	PMSE
DL2	PMSE	TDD	PMSE	UL1	PMSE	TDD	PMSE
DL2	MMS	MMS	PMSE	UL1	PMSE	TDD	PMSE
PMSE	TDD	TDD	TDD	TDD	TDD	TDD	PMSE
PMSE	TDD	TDD	TDD	TDD	TDD	TDD	PMSE
DL2	DL2	PMSE	UL1	UL1	PMSE	TDD	PMSE

4.73 As noted above, uplink services using this spectrum have the potential to cause harmful interference to existing DTT, so potential users should carry out their own assessment of the impact a protection clause might have on their network plans.

**PMSE**

4.74 One of the current uses of UHF Bands IV and V is PMSE. Programme makers, theatres and event organisers use spectrum to relay sound and picture data across relatively short distances. This allows, for example, wireless microphones to be used on stage in musical theatre and at outdoor musical events. Other major uses include IEMs and talkback. All such use tends to be low power. Many PMSE users require assured quality of service to guard against the risk of harmful interference. There may be interest from PMSE stakeholders in acquiring spectrum through the awards of the 600 MHz band and geographic interleaved spectrum.

**BWA**

4.75 Both the 600 MHz band and geographic interleaved spectrum could be used to provide wireless access for broadband services. This could encompass additional facilities in public spaces such as cafés or libraries or new ‘broadband nodes’ in rural areas. Having relatively few, lower-frequency nodes would, however, restrict users’ ability to upload data in comparison with a wireless network of smaller cells at higher frequencies. However, the costs of a smaller-cell network could be prohibitive, especially in remote, sparsely populated areas where broadband access is not easy to deliver via other means. This spectrum might be a more cost effective means of delivering wireless broadband access in some of these areas.

4.76 Providing BWA UK-wide using the 600 MHz band could require up to five channels.

**Emergency services**

4.77 There could be interest in using the 600 MHz band in particular to provide communications services for the emergency services. Significant interest has been expressed by some parties in Europe in using spectrum in the digital dividend for this purpose, ideally on a harmonised basis.

*Question 7: Do you have any comments on our assessment of the most likely uses of the 600 MHz band and geographic interleaved spectrum? Are there any potential uses we have not mentioned that should be considered?*

*Question 8: Are there any distinctive considerations and uses for this spectrum in the nations and regions of the UK?*

## Channel 36

- 4.78 A number of respondents to our December 2006 consultation on our proposed approach to the award of the digital dividend pointed out there would be benefits in awarding channel 36 early so that mobile television and associated applications could be developed and brought to market. They argued for an early and separate award of channel 36. We examined the merits of their case in our December 2007 statement on our approach to awarding the digital dividend but decided not to do this. In our February 2009 consultation on clearing the 800 MHz band, we reached a similar conclusion.
- 4.79 With the clearance of channel 36 in June 2009, we have looked again at the relative merits of an early, separate award and of including channel 36 in the main award of the 600 MHz band. In doing so, we have recognised an early award might make the channel available up to a year earlier than if the channel were included in the main award, although it is difficult to be precise at this stage. Consistent with our approach in our December 2007 statement, we have assessed whether the potential benefits of an early award might be expected to outweigh the potential costs, based on the modelling work set out in that statement.
- 4.80 In our December 2007 statement, we considered the value to consumers and producers that might be generated by a mobile television operator obtaining spectrum in an early award up to three years in advance of the main award of cleared spectrum. The modelling work suggested such earlier award and use of channel 36 for mobile television using the DVB-H standard could have benefits in the region of around £200m to 500m (net present value over 20 years). This modelling was based on market sentiment at that time about the prospects for the market development of, and hence consumer demand for, mobile television.
- 4.81 In looking again at the relative merits of an early award and use of channel 36, we note the application most likely to make use of this spectrum remains mobile television. This is because a mobile television service could be delivered (depending on coverage and capacity) using one 8 MHz channel and spectrum cleared across the UK is likely to be preferable. Hence we still consider mobile television would be the most likely use if channel 36 were awarded early. Nevertheless, we also note other applications – in particular BWA – could make use of the channel, and so we also consider this in looking at the relative merits of an early award below.
- 4.82 Current evidence suggests the expected market development and level of demand for mobile television has fallen since our assessment for the December 2007 statement. For example, demand for mobile television using DVB-H was relatively robust and increasing around the time it was first launched in 2005. This suggested the service might generate a significant degree of consumer and producer value. However, more recent evidence from experience across Europe suggests, on balance, the market has not developed as rapidly as first expected. For example, attempts in 2009 to launch DVB-H mobile television services in both Germany and Hungary have stalled. Subscriber numbers in the United States have been broadly

static since the end of 2007. Furthermore, it is still not certain whether DVB-H will be the main standard for delivering mobile television in Europe.

- 4.83 It is unclear whether BWA could become a mass-market service and so generate significant consumer and producer value. Present evidence suggests a BWA service offered to customers could be competitive with a fixed-line service in terms of speed. For example, the Scottish Government's Broadband Reach initiative has introduced wireless-broadband access with speeds up to 3 Mbs to some households and businesses in places where fixed-line broadband services are not available. However, given fixed-line services cover much of the UK in general and broadband services are also available from mobile network operators, it is not clear whether the demand for a BWA service would be strong. It is also unclear whether channel 36 alone could provide sufficient capacity for a viable BWA service. Therefore, we have found little evidence to suggest the development of a BWA market would lead to a higher value for channel 36 than mobile television.
- 4.84 Overall, we consider the prospect of significant consumer and producer value from use of channel 36 for mobile television is likely to have fallen since our December 2007 statement. This means potential benefits of an early award and use of the channel are also likely to have fallen. Moreover, such benefits might only be available for up to a year rather than the three years we assumed in the statement.
- 4.85 There is a risk an early award could have a high opportunity cost by distorting the outcome of the main award of the 600 MHz band. This could occur if an operator was discouraged from bidding for channel 36 in any early award if, for the service it had in mind, it needed to acquire other channels to complement channel 36. This is because, at the time of the award of channel 36, the operator would face uncertainty over whether it could acquire the necessary other channels in the later award. As a result, the early award could create an opportunity cost since it might discourage bidding by users that could make high-value use of the 600 MHz band and so distort an efficient overall award outcome. We recognise secondary trading of spectrum could, in principle, mitigate this opportunity cost as there would be the potential for holders and purchasers to trade on a mutually beneficial basis so a higher overall value for the spectrum was reached. Nevertheless, we consider, on balance, an award of the 600 MHz band that included channel 36 is likely to lead to a more efficient outcome than relying on the secondary market.
- 4.86 Separately, we suggested in previous statements any early use of channel 36 should be conditional on not imposing costs on viewers and producers by materially interfering with and degrading Five's analogue television service using channels 35 and 37. This remains the case, but we do not now consider such costs of interference are likely to be material. This is largely because, by the time any completed network using channel 36 is rolled out, DSO will be well advanced and so most, if not all, analogue Five broadcasts will already have ceased.
- 4.87 On the basis of present evidence, we continue to believe we should include channel 36 in the award of the 600 MHz band and not award it separately in advance. We consider the benefits of an early award to be low or uncertain, while there is a material risk of incurring significant costs, primarily by distorting the outcome of the main award of the 600 MHz band.

*Question 9: Do you have any comments on our continued inclusion of channel 36 in the award of the 600 MHz band?*

## A market-led approach to awarding the digital dividend

- 4.88 A fundamental strategic choice we faced in relation to the digital dividend was what level of control to impose on its future use. We did not think a fundamentally interventionist approach was right or sustainable in the digital age. It is increasingly inappropriate to use spectrum as a policy instrument when the variety of uses is so great and there are many options for securing value for society. In particular, in our December 2007 statement on our approach to awarding the digital dividend, we considered if we picked preferred uses or users of the spectrum, we would:
- distort incentives to use the spectrum efficiently;
  - reduce the scope for responding flexibly to developments that called for changed use of the spectrum;
  - risk distorting competition and reducing innovation by denying access to the spectrum other than to preferred users; and
  - risk picking a use or user that did not generate the most value for society.
- 4.89 For these reasons, we preferred a market-led approach.
- 4.90 We noted nevertheless markets and market outcomes, under certain circumstances, can become subject to failure; meaning they may fail to maximise total value to society. In such cases, it would be appropriate to consider remedies to any such failures to maximise the value of the digital dividend to citizens and consumers. We set out an analytical framework for considering market failures, possible remedies and the costs of those remedies.
- 4.91 We concluded a market-led approach to awarding the spectrum was generally most likely to meet our objective. However, there was a risk of market failure if we required local television operators to coordinate their bids for UK-wide packages. As a consequence, we decided to auction geographic packages of interleaved spectrum in specific locations that matched the pattern of demand for local television. Those packages would be suitable but not reserved for use by local television.
- 4.92 We do not believe developments over the last two years suggest we should modify this approach in formulating proposals for awarding the 600 MHz band and geographic interleaved spectrum or there are new risks of market failure that would justify further intervention.

*Question 10: Do you have any comments on our intention to maintain a market-led approach to awarding the 600 MHz band and geographic interleaved spectrum?*

## Packaging and award design

- 4.93 Part of our market-led approach is to favour auctions as the most appropriate way of awarding spectrum. In making spectrum available to users in this way, we need to package it into lots for which bids may be made. It is important we do this in a way that facilitates efficient use and enables maximum flexibility of use by the range of services it might support. This means we need to understand the most likely uses of the spectrum in order to design appropriate packages.
- 4.94 Spectrum packaging and auction design are closely linked. For example, consider the position of an operator who needs 32 MHz of spectrum to provide a mobile

service. We could address this by offering packages of 32 MHz or by offering packages of 8 MHz with the opportunity in the auction process to aggregate them into a 32 MHz block. The decision on which of these courses we should take would depend on whether there was a variety of potential uses and/or spectrum requirements (e.g. some users needing 8 MHz while others needed 16 MHz or more). Where we decide to follow the aggregation route, the choice of auction design must take account of the need to facilitate the aggregation of lots.

- 4.95 Our June 2008 consultations covered these issues in some detail and put forward detailed proposals for packaging and award design. These proposals necessarily reflected the circumstances at the time, including our expectation we would award geographic interleaved spectrum separately and after the award of the cleared spectrum. As explained in section 3, important decisions have been made since June 2008 on the make-up of the digital dividend. In particular, there will be separate awards of the 600 and 800 MHz bands. The availability of geographic interleaved spectrum will also be indirectly affected. These developments mean we must reconsider our approach to packaging and award design for the 600 MHz band and geographic interleaved spectrum. Stakeholders' views concerning potential uses of and demand for this spectrum will be a key input in our reconsideration. The following paragraphs illustrate the type of packaging and auction-design issues we will need to consider. We hope this will help stakeholders in considering the information they might provide on potential uses of the spectrum.

## Packaging

- 4.96 Packages of spectrum to be awarded should, as closely as possible, reflect the potential demand. Packaging will also need to reflect specific constraints on the spectrum in question (e.g. the outcome of international negotiations). Spectrum may also be subject to specific rights and obligations to be included in the licences to be awarded. These may also have a bearing on how the spectrum is packaged.
- 4.97 At the beginning of this section, we described in broad terms what 600 MHz and geographic interleaved spectrum will be awarded. In preparing for the awards, we will need to decide:
- the way the spectrum should be divided into lots by bandwidth;
  - the geographic coverage of lots; and
  - the guard bands, if any, between neighbouring users of the spectrum.
- 4.98 The bandwidth of lots to be awarded is very closely linked to how the spectrum might be used. At present, the 600 MHz band is divided into 8 MHz channels and used for terrestrial television. Where this remains the most likely use, it would be most efficient to offer lots of this size. But where other uses are possible, different-size lots might be more appropriate. For example, TDD and FDD variants of two-way communications technologies that are currently specified in Europe are likely to operate on a basis of 5 MHz channels or multiples thereof. In the case of our proposals for the geographic interleaved awards, we saw DTT as the most likely use and proposed packaging the spectrum into 8 MHz lots. This may no longer be appropriate. To assess whether this is the case, we are seeking views on possible uses and technologies.
- 4.99 The geographic dimension of the spectrum to be offered differs between the 600 MHz band and the geographical interleaved spectrum. Channels in the 600 MHz

band will be available for use throughout the UK, although there are likely to be constraints on certain uses in some areas due to international agreements. It would clearly be possible to offer the spectrum as UK-wide lots. It would also be possible to offer it in smaller, geographically defined lots, on a regional, national or some other basis. We will take into account stakeholders' interests in the services and coverage they would like to provide in making proposals for how we should geographically package the band.

- 4.100 The geographic interleaved spectrum is different from the 600 MHz band in terms of coverage. The spectrum may be used in areas where it is not needed for the six existing DTT multiplexes. In our June 2008 consultation, we identified channels in 81 areas that might be included in the geographic interleaved awards. We will not know whether the same or alternative channels will be available at any or all of those sites until sufficient progress has been made in the international negotiations described above. But we consider there will be suitable channels available in many areas. The list included a number of areas in which stakeholders expressed an interest in acquiring spectrum for local television, and in finalising the lots of geographic interleaved spectrum to be awarded, we expect again to take expressions of interest into account. Stakeholders might also be interested in aggregating a number of lots into national, regional or other packages. If so, we will need to consider how best to facilitate this in designing the award.
- 4.101 The need for and size of guard bands depends critically on the likely uses of the spectrum. Guard bands are designed to avoid harmful interference between adjacent spectrum uses. They may not be necessary where adjacent uses are similar or harmful interference is mitigated by block-edge masks. Their size and position therefore depend very much on the spectrum uses and technologies in question. For example, as discussed in paragraph 4.30, guard bands may be necessary between spectrum used for mobile services and DTT. Again, in order to give the question proper consideration, we need stakeholders' input on potential uses.

## **Award design**

- 4.102 Our June 2008 consultations discussed how the demand for spectrum might influence award design. The relevant award-design parameters included:
- simultaneous or sequential award of lots;
  - single- or multiple-round auctions;
  - package bidding or bids for individual lots; and
  - generic or specific lots.
- 4.103 Our consultations explained the issues associated with these design parameters. We briefly recap the issues here and discuss their relevance for the award of the 600 MHz band and geographic interleaved spectrum.

### Simultaneous or sequential award of lots

- 4.104 Lots may be sold either simultaneously (all at the same time) or sequentially (one after the other). An important determinant of which would be more efficient is the degree to which lots are substitutes for or complements to each other.

- 4.105 For example, in order to construct a UK-wide DTT multiplex using cleared spectrum, a potential bidder would probably prefer lots that can enable signals to be received by each of the different aerial groups. Therefore, two lots in different aerial groups may be strong complements, since a UK-wide network would ideally require access to both. However, two lots within the same aerial group may be substitutes, so a bidder looking to roll out a UK-wide multiplex may largely be indifferent to obtaining one or the other. Similar considerations apply to the other potential services that may make use of this spectrum.
- 4.106 Bidders will be in a difficult position where lots that are either substitutable or complementary are auctioned sequentially. They will have to bid for one lot without knowing what the price of other substitute lots may be in later auctions. (This is called a substitution risk.) In the case of complementary lots, they will have to bid without knowing whether they will be successful in winning in later auctions the complementary lots they need. (This is called an aggregation risk.) By contrast, a simultaneous auction, which allows bids on all lots in a single process, can enable bidders to manage both aggregation and substitution risks.

#### Single- or multiple-round auctions

- 4.107 Spectrum has been awarded using both single-round sealed-bid auctions and multiple-round open ascending-bid auctions. Sealed bids are often favoured for their administrative simplicity and because, where there are significant bidder asymmetries and related concerns about the level of competition in the auction, they can encourage wider participation. However, in the absence of competition concerns, multiple-round auctions may promote more efficient outcomes. In particular, such auctions allow bidders to obtain further information on the value of lots by observing the behaviour of competitors for the same spectrum over the course of the auction. This can help refine their assessment of their own requirements and potentially mitigate the “winner’s curse” (i.e. the risk bidders may overvalue the spectrum due to a lack of information).

#### Package bidding or bids for individual lots

- 4.108 In auctions with multiple lots, bidders seeking aggregations of lots may face an aggregation risk. As noted above, this risk arises when there are multiple lots that are complementary for a bidder. Unless ‘package bids’ are allowed, the bidder has to bid separately for one lot without being sure whether, and at what price, it might win the complementary lot(s). In such a situation, the bidder faces the risk it might win only a subset of the lots it requires, which would be inefficient. Further, such risk tends to encourage conservative bidding, which may mean bidders fail to win the appropriate number of lots even though they may have the highest valuation on those lots.
- 4.109 One solution to this problem is to design an auction so bidders are able to make package bids (i.e. linked bids for multiple lots that are accepted or rejected in their entirety). Package bidding, however, can raise other risks. For example, where a large bidder and a set of smaller bidders are interested in the same package of lots, it could reduce the likelihood of the group of smaller bidders winning, even where their collective valuation is higher than the large bidder’s. This is because smaller bidders would need to coordinate their demand and might find this difficult, whereas the larger bidder would face no difficulty in making one bid on a package of spectrum.



## Generic or specific lots

- 4.110 Multiple lots can be auctioned on either a specific or a generic basis. With specific lots, bidders place bids for lots at specific frequencies. By contrast, bidders simply specify the number of generic lots they want, without the lots being defined by particular frequencies. The award process allows for the translation of generic lots into the specific frequencies to be awarded to winning bidders.
- 4.111 The use of generic lots is appropriate if bidders are indifferent to specific frequencies within a given band. If, in contrast, bidders have an interest in obtaining specific frequencies, packaging the spectrum as generic lots would not be appropriate.
- 4.112 This will not be an issue in the geographic interleaved awards as the spectrum to be awarded will be defined by channel and transmission site. But it would be feasible to divide the 600 MHz band into generic lots of a defined size.

## **Information relevant to packaging and award design**

- 4.113 Bearing in mind the variety of parameters for both packaging and award design, we invite stakeholders to contribute to updating our understanding of likely demand and other issues and provide us with information that will help us to develop options for packaging and award design and meet the needs of those interested in acquiring and using this spectrum.
- 4.114 Relevant information includes:
- uses and applications for the spectrum, including the relevant technologies;
  - the geographic coverage and bandwidth needed to support potential uses, applications and technologies;
  - the extent to which bidders might see frequency lots as substitutes for or complements to each other;
  - the degree to which lots might usefully be aggregated and the extent of any aggregation risk for bidders; and
  - whether those interested in the 600 MHz band would want the spectrum to be offered as generic or specific lots.

*Question 11: What information can you provide on packaging and award-design considerations?*

## **When will stakeholders want to operate new services using this spectrum?**

- 4.115 Another important question is when we should hold the awards. To help us consider this, we would like to know when stakeholders are likely to want to develop services using the 600 MHz band and/or geographic interleaved spectrum. It would also be helpful to know when they would like certainty on the timing of awards to plan the introduction of new services. We will take comments into account in planning the awards, although timing will also depend on the outcome of international negotiations. We cannot proceed with awards until spectrum availability is certain.

*Question 12: When would you like to start operating new services using the 600 MHz band and/or geographic interleaved spectrum?*

## Section 5

# Next steps

- 5.1 This consultation, published on 18 February 2010, lasts for a ten-week period. The closing date for responses is 28 April 2010. See annex 1 for details of how to respond to this consultation.
- 5.2 Following the closing date, we will develop options for packaging and award design, taking into consideration stakeholder responses and other relevant information and developments. We will then publish detailed proposals for the award of both the 600 MHz band and the geographic interleaved spectrum but not before it is certain what spectrum will be available for award. This is unlikely to be before mid-2010. We shall include in that consultation an impact assessment of the options we put forward.
- 5.3 We would be very happy to discuss the issues raised in this consultation with stakeholders. Please contact Matthew Conway on 020 7981 3082 or at [matthew.conway@ofcom.org.uk](mailto:matthew.conway@ofcom.org.uk) if you would like to arrange a discussion.

## Annex 1

# Responding to this consultation

## How to respond

- A1.1 We invite written views and comments on the issues raised in this document, to be made by 5 p.m. on 28 April 2010.
- A1.2 We strongly prefer to receive responses using the online web form at [https://www.ofcom.org.uk/consult/condocs/600mhz\\_geographic/howtorespond/form](https://www.ofcom.org.uk/consult/condocs/600mhz_geographic/howtorespond/form) as this helps us to process the responses quickly and efficiently. We would also be grateful if you could assist us by completing a response cover sheet (see annex 3) to indicate whether there are confidentiality issues. This response cover sheet is incorporated into the online web-form questionnaire.
- A1.3 For larger consultation responses – particularly those with supporting charts, tables or other data – please email [matthew.conway@ofcom.org.uk](mailto:matthew.conway@ofcom.org.uk), attaching your response in Microsoft Word format, together with a response cover sheet.
- A1.4 Responses may alternatively be posted to the address below, marked with the title of the consultation.

Matthew Conway  
Director of Spectrum Policy (Market Enhancement)  
Ofcom  
Riverside House  
2a Southwark Bridge Road  
London SE1 9HA

Note we do not need a hard copy in addition to an electronic version. We will acknowledge receipt of responses if they are submitted using the online web form but not otherwise.

- A1.5 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together in annex 4. It would also help if you could explain why you hold your views and how our proposals would impact on you.

## Further information

- A1.6 If you want to discuss the issues and questions raised in this consultation or need advice on the appropriate form of response, please contact Matthew Conway on 020 7981 3082.

## Confidentiality

- A1.7 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk), ideally on receipt. If you think your response should be kept confidential, please specify what part and why. Please also place such parts in a separate annex.

- A1.8 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and try to respect it. But sometimes we will need to publish all responses, including those that are marked as confidential, in order to meet legal obligations.
- A1.9 Please also note copyright and all other intellectual property in responses will be assumed to be licensed to us to use. Our approach to intellectual property rights is explained further on our website at [www.ofcom.org.uk/about/accoun/disclaimer/](http://www.ofcom.org.uk/about/accoun/disclaimer/).

### Next steps

- A1.10 Following the end of the consultation period, we intend to publish detailed proposals for the award of both the 600 MHz band and the geographic interleaved spectrum in due course.
- A1.11 Please note you can register to receive free mail updates alerting you to the publications of relevant Ofcom documents. For more details, please see [www.ofcom.org.uk/static/subscribe/select\\_list.htm](http://www.ofcom.org.uk/static/subscribe/select_list.htm).

### Our consultation processes

- A1.12 We seek to ensure responding to a consultation is easy as possible. For more information, please see our consultation principles in annex 2.
- A1.13 If you have any comments or suggestions on how we conduct our consultations, please call our consultation helpdesk on 020 7981 3003 or email us at [consult@ofcom.org.uk](mailto:consult@ofcom.org.uk). We would particularly welcome thoughts on how we could more effectively seek the views of those groups or individuals, such as small businesses or particular types of residential consumer, who are less likely to give their opinions through a formal consultation.
- A1.14 If you would like to discuss these issues or our consultation processes more generally, you can alternatively contact Vicki Nash, Director Scotland, who is our consultation champion.

Vicki Nash  
Ofcom  
Sutherland House  
149 St. Vincent Street  
Glasgow G2 5NW

Tel: 0141 229 7401  
Fax: 0141 229 7433

Email [vicki.nash@ofcom.org.uk](mailto:vicki.nash@ofcom.org.uk)

## Annex 2

# Our consultation principles

A2.1 We have published the following seven principles that we will follow for each public written consultation:

### Before the consultation

A2.2 Where possible, we will hold informal talks with people and organisations before announcing a big consultation to find out whether we are thinking in the right direction. If we do not have enough time to do this, we will hold an open meeting to explain our proposals shortly after announcing the consultation.

### During the consultation

A2.3 We will be clear about whom we are consulting, why, on what questions and for how long.

A2.4 We will make the consultation document as short and simple as possible, with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

A2.5 We will consult for up to ten weeks depending on the potential impact of our proposals.

A2.6 A person within Ofcom will be in charge of making sure we follow our own guidelines and reach out to the largest number of people and organisations interested in the outcome of our decisions. Our consultation champion will also be the main person to contact with views on the way we run our consultations.

A2.7 If we are not able to follow one of these principles, we will explain why.

### After the consultation

A2.8 We think it is important for everyone interested in an issue to see the views of others during a consultation. We would usually publish all the responses we have received on our website. In our statement, we will give reasons for our decisions and an account of how the views of those concerned helped shape them.

## Annex 3

# Response cover sheet

- A3.1 In the interests of transparency and good regulatory practice, we will publish all consultation responses in full on our website, [www.ofcom.org.uk](http://www.ofcom.org.uk).
- A3.2 We have produced a cover sheet for responses (see below) and would be very grateful if you could send one with your response. (It is incorporated into the online web form if you respond in this way.) This will speed up our processing of responses and help to maintain confidentiality where appropriate.
- A3.3 The quality of consultation can be enhanced by publishing responses before the consultation period closes. In particular, this can help those individuals and organisations with limited resources or familiarity with the issues to respond in a more informed way. Therefore, we encourage respondents to complete their cover sheet in a way that allows us to publish their responses upon receipt rather than waiting until the consultation period has ended.
- A3.4 We strongly prefer to receive responses via the online web form, which incorporates the cover sheet. If you are responding via email or post, you can download an electronic copy of this cover sheet in Word or RTF format from the consultations section of our website at [www.ofcom.org.uk/consult/](http://www.ofcom.org.uk/consult/).
- A3.5 Please put any parts of your response you consider should be kept confidential in a separate annex to your response and include your reasons why this part of your response should not be published. This can include information such as your personal background and experience. If you want your name, address, other contact details or job title to remain confidential, please provide them in your cover sheet only so we don't have to edit your response.

## Cover sheet for response to an Ofcom consultation

### BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

### CONFIDENTIALITY

Please tick below what part of your response you consider is confidential, giving your reasons why

Nothing  Name/contact details/job title

Whole response  Organisation

Part of the response  If there is no separate annex, which parts?

If you want part of your response, your name or your organisation not to be published, can we still publish a reference to the contents of your response (including, for any confidential parts, a general summary that does not disclose the specific information or enable you to be identified)?

### DECLARATION

I confirm the correspondence supplied with this cover sheet is a formal consultation response that Ofcom can publish. However, in supplying this response, I understand Ofcom may need to publish all responses, including those marked as confidential, in order to meet legal obligations. If I have sent my response by email, Ofcom can disregard any standard email text about not disclosing email contents and attachments.

Ofcom seeks to publish responses on receipt. If your response is non-confidential (in whole or in part) and you would prefer us to publish your response only once the consultation has ended, please tick here.

Name

Signed (if hard copy)

## Annex 4

# Consultation questions

*Question 1: Do you have any comments on the application of the protection clause to all new licences for the 600 MHz band and geographic interleaved spectrum?*

*Question 2: Do you have any comments on our approach to technical licence conditions for the 600 MHz band and geographic interleaved spectrum?*

*Question 3: Do you have any evidence using frequency offsets with DVB-T2 EC signals might have an adverse impact on uses of adjacent interleaved spectrum?*

*Question 4: Do you have any evidence mobile services using the 600 MHz band and geographic interleaved spectrum could cause harmful interference to cable television?*

*Question 5: Do you have any comments on protecting PMSE in channel 38?*

*Question 6: Do you have any comments on non-technical licence issues and the way we propose to approach them?*

*Question 7: Do you have any comments on our assessment of the most likely uses of the 600 MHz band and geographic interleaved spectrum? Are there any potential uses we have not mentioned that should be considered?*

*Question 8: Are there any distinctive considerations and uses for this spectrum in the nations and regions of the UK?*

*Question 9: Do you have any comments on our continued inclusion of channel 36 in the award of the 600 MHz band?*

*Question 10: Do you have any comments on our intention to maintain a market-led approach to awarding the 600 MHz band and geographic interleaved spectrum?*

*Question 11: What information can you provide on packaging and award design considerations?*

*Question 12: When would you like to start operating new services using the 600 MHz band and/or geographic interleaved spectrum?*



## Annex 5

# DVB-T2 and frequency offsets

A5.1 DSO is now well established, with some regions such as Border, West Country and Granada already having completed the transition to all-DTT broadcasting. In December 2009, there was a further development when the first HD services were launched at the Winter Hill transmitter in the Granada region. These are broadcast using a new type of digital signal called DVB-T2, which exhibits different technical characteristics from the longer-established DVB-T standard already in use in the UK. Those differences are described below. We are seeking views on whether this is likely to have any impact on the use of geographic interleaved spectrum for services other than DTT (see paragraphs 4.31-4.38 of this consultation).

## DVB-T and DVB-T2

A5.2 Two types of DVB signal are designed for terrestrial fixed reception use: DVB-T and the newer DVB-T2. The UK's six existing DTT multiplexes have used DVB-T since their launch in the late 1990s. One (Multiplex B, licensed to the BBC) is being progressively changed to use DVB-T2 as DSO progresses across the UK. In regions where DSO occurred before December 2009, Multiplex B will be converted to operate with DVB-T2 before November 2010.

A5.3 DVB-T2 offers a greater data capacity than the older DVB-T standard, and Multiplex B needs this extra capacity to be able to accommodate a viable number of HD television services.<sup>45</sup> DVB-T signals are compatible with existing DTT receivers, while viewers who wish to receive the DVB-T2 signals will need to purchase a new receiver (which will also be compatible with DVB-T signals).

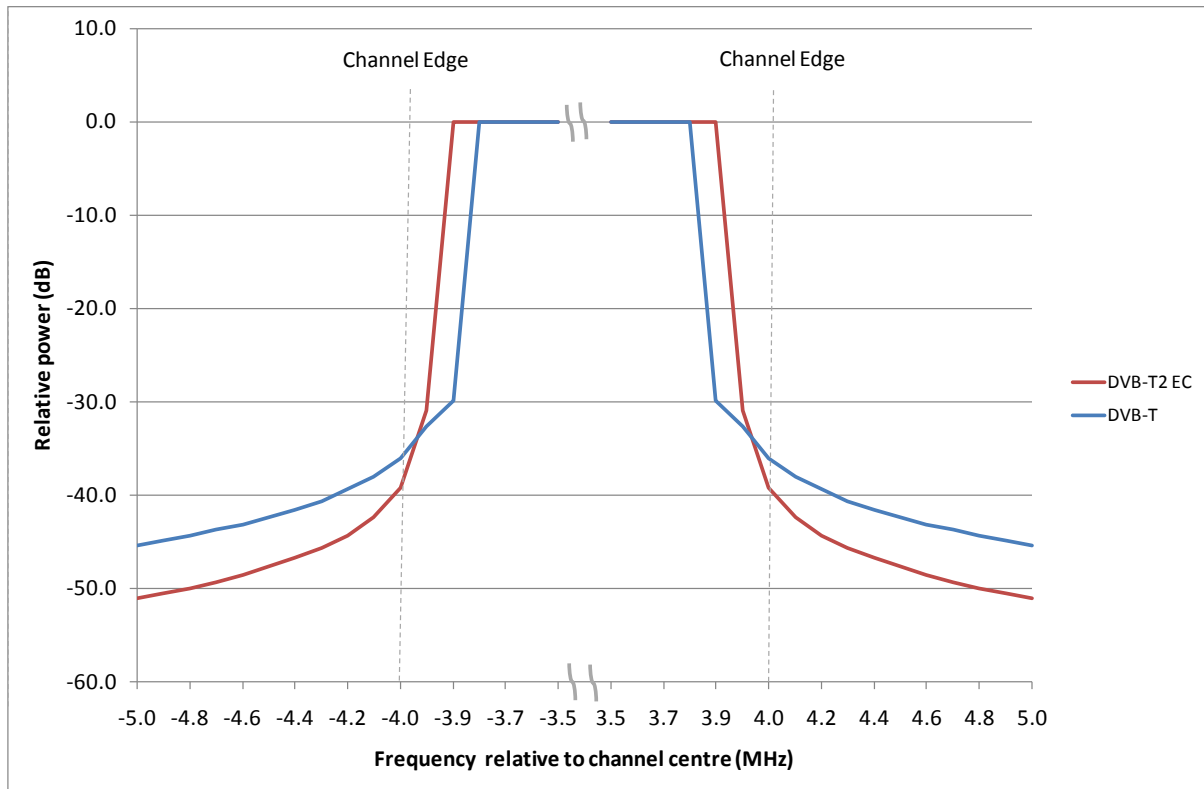
A5.4 A DVB signal consists of a large number of individual signals that collectively carry the data broadcast in a multiplex. Both DVB-T and DVB-T2 signals nearly fully occupy a standard 8 MHz wide channel, leaving just small gaps between the edge of the signals and the channel edge. For DVB-T, this gap is approximately 185 kHz. A DVB-T2 signal is either the same size or slightly larger if EC mode is employed, reducing the gap to the channel edge to 115 kHz.

A5.5 Figure A1 shows ideal predicted spectral occupancy for DVB-T and DVB-T2 EC-mode signals. In practice, the signal levels would be slightly different due to distortions such as intermodulation in the transmitter.

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<sup>45</sup> For a given transmitter power and coverage, DVB-T2 offers an increase of 50-70% over DVB-T in the amount of data that can be carried within a multiplex. This currently permits three HD services to be carried.

**Figure A1. Spectra of ideal DVB-T and DVB-T2 signals**



**Practical implementation and frequency offsets**

A5.6 While the wanted part of a DVB signal fits inside an 8 MHz channel, some energy produced extends outside. To minimise the amount of interference experienced by other spectrum users, limits are placed on these out-of-band emissions. The limits for the spectrum used for terrestrial television are set out in IR2022 and are stricter at the boundaries of the spectrum planned to be used by the six existing multiplexes (e.g. at the lower side of channel 21 and the upper side of channel 30). In addition to the band-edge channels, practical implementation factors lead to increased filtering requirements in the channel combiners where multiplexes occupy adjacent channels at a transmitter.

A5.7 Where there is a band edge or adjacent multiplex, the broadcasters and transmission companies usually offset the frequency of the DVB signals within their channels in the opposite direction. This offset increases the space between the DVB signal and the band edge or adjacent multiplex and results in their being able to meet the out-of-band requirements of IR2022 using filters with a less sharp characteristic than would otherwise be necessary. Consequently, the filters are generally smaller and easier to obtain at a significant cost saving without causing a detrimental effect on other spectrum users. The frequency offset used is always  $\pm 167$  kHz. This value has been included in the Digital Television Group’s (DTG) *Digital Terrestrial Television Requirements for Interoperability* (also known as the D-Book) since the late 1990s,<sup>46</sup> and receivers have been developed on that basis.

<sup>46</sup> See [DTG Books and White Papers](#). The D-Book is available to DTG full members only.

## Annex 6

# Legal and regulatory framework

A6.1 This annex describes our functions, duties and objectives as they relate to spectrum awards. It also provide a brief overview of the international provisions that impact on the potential future uses of spectrum in the UK.

### Our functions, duties and objectives

A6.2 We make decisions within a framework defined in EU and UK law. This sets out overarching general duties that apply across all our functions, below which sit a number of specific duties.<sup>47</sup>

A6.3 Following a recent review, a number of changes will be made to the EU regulatory framework.<sup>48</sup> Member States are required to implement them in national law by 25 May 2011. A new Body of European Regulators for Electronic Communications has also been established.<sup>49</sup> This annex considers the regulatory framework as it currently applies.

### The duties imposed by the Communications Act 2003

A6.4 Section 3 of the Communications Act 2003<sup>50</sup> sets out our general duties and provides our principal duty is:

- to further the interests of citizens in relation to communications matters; and
- to further the interests of consumers in relevant markets, where appropriate by promoting competition.

A6.5 In securing the above duties, we are required to secure among other things the optimal use for wireless telegraphy of the electromagnetic spectrum and the availability throughout the UK of a wide range of electronic communication services and to have regard to the different needs and interests of everyone who may wish to use the spectrum for wireless telegraphy.

A6.6 Section 3(3) of the Communications Act provides we must in all cases have regard to the principles of transparency, accountability, proportionality and consistency in performing our principal duty as well as ensure our actions are targeted only at cases in which action is needed.

A6.7 Section 3(4) of the Communications Act requires us in performing our principal duty to have regard to a number of factors as appropriate, including the desirability of promoting competition, encouraging investment and innovation in relevant markets and encouraging the availability and use of high-speed data-transfer services throughout the UK.

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<sup>47</sup> See annex 6 of our December 2007 statement on our approach to awarding the digital dividend for a more detailed overview of the statutory duties relevant to the DDR.

<sup>48</sup> See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0011:0036:EN:PDF> and <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0037:0069:EN:PDF>.

<sup>49</sup> See <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2009:337:0001:0010:EN:PDF>.

<sup>50</sup> [www.opsi.gov.uk/acts/acts2003/pdf/ukpga\\_20030021\\_en.pdf](http://www.opsi.gov.uk/acts/acts2003/pdf/ukpga_20030021_en.pdf).

- A6.8 Where there is a conflict between the duties, priority must be given to the European Community requirements set out in section 4.

### **European Community requirements**

A6.9 Section 4 of the Communications Act implements article 8 (policy objectives and regulatory principles) of the Framework Directive.<sup>51</sup> This sets out the objectives national regulatory authorities must take all reasonable steps to achieve. These include promoting competition in the provision of electronic communications networks and services by, among other things, encouraging efficient investment in infrastructure and promoting innovation, and encouraging efficient use of radio frequencies; and contributing to the development of the internal market by, among other things, removing obstacles to the provision of electronic communications networks and services at a European level, encouraging the interoperability of pan-European services and ensuring there is no discrimination in the treatment of undertakings providing electronic communications networks and services in similar circumstances.

A6.10 Article 8 also requires Member States to ensure national regulatory authorities take the utmost account of the desirability of making regulations technologically neutral in carrying out their regulatory tasks.

### **Our duties when carrying out our spectrum functions**

A6.11 In carrying out our spectrum functions, we have a duty under section 3 of the Wireless Telegraphy Act 2006<sup>52</sup> to have regard in particular to:

- the extent to which the spectrum is available for use or further use for wireless telegraphy;
- the demand for use of that spectrum for wireless telegraphy; and
- the demand that is likely to arise in future for the use of that spectrum for wireless telegraphy.

A6.12 We also have a duty to have regard, in particular, to the desirability of promoting:

- the efficient management and use of the spectrum for wireless telegraphy;
- the economic and other benefits that may arise from the use of wireless telegraphy;
- the development of innovative services; and
- competition in the provision of electronic communications services.

A6.13 Where it appears to us any of our duties in section 3 of the Wireless Telegraphy Act conflicts with one or more of our general duties under sections 3-6 of the Communications Act, priority must be given to our duties under the latter. Section 5 of the Communications Act concerns our obligation to carry out our functions in accordance with any directions made by the Secretary of State. Section 6 concerns our duties to review regulatory burdens.

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<sup>51</sup> [http://eur-lex.europa.eu/pri/en/oj/dat/2002/l\\_108/l\\_10820020424en00330050.pdf](http://eur-lex.europa.eu/pri/en/oj/dat/2002/l_108/l_10820020424en00330050.pdf).

<sup>52</sup> [www.opsi.gov.uk/acts/acts2006/pdf/ukpga\\_20060036\\_en.pdf](http://www.opsi.gov.uk/acts/acts2006/pdf/ukpga_20060036_en.pdf).

## **Granting wireless telegraphy licences**

- A6.14 The Wireless Telegraphy Act sets out our legal power to grant wireless telegraphy licences. Section 8(1) makes it an offence for any person to establish or use any station for wireless telegraphy or to install or use any apparatus for wireless telegraphy except under and in accordance with a licence granted by us under that section (a wireless telegraphy licence).
- A6.15 Section 9(1) of the Wireless Telegraphy Act gives us the power to grant wireless telegraphy licences subject to such terms as we think fit.
- A6.16 However, our broad discretion in relation to the terms that can be imposed in a wireless telegraphy licence is subject to the rule we must impose only those terms that we are satisfied are objectively justifiable in relation to the networks and services to which they relate, not unduly discriminatory and proportionate and transparent as to what they are intended to achieve (see section 9(7)).
- A6.17 Under section 8(4) of the Wireless Telegraphy Act, we have the duty to exempt from licensing any use of wireless telegraphy apparatus that we consider is not likely to cause harmful interference. Licence exemptions are granted by way of regulations made under section 8(3).

## **Providing for the award of wireless telegraphy licences**

- A6.18 Under Article 5(2) of the Authorisation Directive,<sup>53</sup> when granting rights of use of radio frequencies (wireless telegraphy licences in the UK), Member States must do so through open, transparent and non-discriminatory procedures.
- A6.19 Under Article 7(2) of the Authorisation Directive, where the number of rights of use of radio frequencies needs to be limited, Member States' selection criteria must be objective, transparent, non-discriminatory and proportionate. Section 29 of the Wireless Telegraphy Act requires us to make an order setting out the criteria.
- A6.20 Within this context, we have the power under section 14 of the Wireless Telegraphy Act (having regard to the desirability of promoting the optimal use of the electromagnetic spectrum) to make regulations providing applications for the grant of wireless telegraphy licences must be made in accordance with a procedure that involves the applicants making bids for licences (e.g. an auction).
- A6.21 We have broad powers under section 14 to make provision in regulations for the form of the licences and the auction procedure.

## **Charging fees for wireless telegraphy licences**

- A6.22 Under Article 13 of the Authorisation Directive, any fees imposed for rights of use of radio frequencies must reflect the need to ensure the optimal use of the resources. Such fees must be objectively justifiable, transparent, non-discriminatory and proportionate in relation to their intended purpose and take into account the objectives set out in article 8 of the Framework Directive.
- A6.23 Section 12 of the Wireless Telegraphy Act permits charging for wireless telegraphy licences by enabling us to prescribe in regulations sums payable for these licences. This power enables us to recover the cost of administering and managing wireless

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<sup>53</sup> [http://eur-lex.europa.eu/pri/en/oj/dat/2002/l\\_108/l\\_10820020424en00210032.pdf](http://eur-lex.europa.eu/pri/en/oj/dat/2002/l_108/l_10820020424en00210032.pdf).

telegraphy licences. Section 13 of the Wireless Telegraphy Act permits us to recover sums greater than these if we think fit in the light (in particular) of the matters to which we must have regard under section 3, including promoting the efficient management and use of the part of the electromagnetic spectrum available for wireless telegraphy.<sup>54</sup>

- A6.24 The fees for most wireless telegraphy licences (including those fees we set out in order to incentivise the efficient use of the spectrum) are set out in specific regulations. The current regulations are the Wireless Telegraphy (Licence Charges) Regulations 2005 (SI 2005/1378) as amended.<sup>55</sup>

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<sup>54</sup> Clause 38 of the Digital Economy Bill amends section 12 to provide for the charging of fees for licences awarded by auction in specified circumstances. See

[www.publications.parliament.uk/pa/ld200910/ldbills/001/2010001.pdf](http://www.publications.parliament.uk/pa/ld200910/ldbills/001/2010001.pdf).

<sup>55</sup> [www.opsi.gov.uk/SI/si2006/20062894.htm](http://www.opsi.gov.uk/SI/si2006/20062894.htm).

## Annex 7

# Glossary of abbreviations

<b>3G</b>	Third generation mobile phone standards and technology
<b>AVC</b>	Advanced video coding
<b>BIS</b>	Department for Business, Innovation and Skills
<b>BWA</b>	Broadband wireless access
<b>dB</b>	Decibel
<b>DCMS</b>	Department for Culture, Media and Sport
<b>DDR</b>	Digital Dividend Review
<b>DL</b>	Downlink
<b>DSO</b>	Digital switchover
<b>DTG</b>	Digital Television Group
<b>DTT</b>	Digital terrestrial television
<b>DVB-H</b>	Digital Video Broadcast – Handheld
<b>DVB-T</b>	Digital Video Broadcast – Terrestrial
<b>EC</b>	Extended carrier
<b>EU</b>	European Union
<b>FDD</b>	Frequency-division duplexing
<b>GE06</b>	Geneva 2006 agreement
<b>HD</b>	High definition
<b>IEM</b>	In-ear monitor
<b>IFNC</b>	Independently funded news consortium
<b>IR2022</b>	Interface Requirement 2022
<b>ISB</b>	Independent spectrum broker
<b>kbs</b>	Kilobits per second
<b>kHz</b>	KiloHertz
<b>LMC</b>	Local multimedia company
<b>Mbs</b>	Megabits per second

<b>MHz</b>	Megahertz
<b>MMS</b>	Mobile multimedia service
<b>MOU</b>	Memorandum of understanding
<b>MPEG</b>	Moving Picture Experts Group
<b>NGW</b>	National Grid Wireless
<b>PMSE</b>	Programme-making and special events
<b>PSB</b>	Public-service broadcasting
<b>QAM</b>	Quadrature amplitude modulation
<b>QPSK</b>	Quadrature phase-shift keying
<b>RTSL</b>	Restricted television service licence
<b>SD</b>	Standard definition
<b>SURs</b>	Spectrum usage rights
<b>TDD</b>	Time-division duplexing
<b>TLC</b>	Technical licence condition
<b>UHF</b>	Ultra-high frequency
<b>UL</b>	Uplink